

# Implementing nuclear non-proliferation in Finland

Regulatory control, international  
cooperation and the Comprehensive  
Nuclear-Test-Ban Treaty

Annual report 2012

Olli Okko (ed)

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## Executive summary

The regulatory control of nuclear materials (nuclear safeguards) is a prerequisite for the peaceful use of nuclear energy in Finland. In order to uphold the Finnish part of the international agreements on nuclear non-proliferation – mainly the Non-Proliferation Treaty (NPT) – this regulatory control is exercised by the Nuclear Materials Section of the Finnish Radiation and Nuclear Safety Authority (STUK).

The results of STUK's nuclear safeguards inspection activities in 2012 continued to demonstrate that the Finnish licence holders take good care of their nuclear materials. There were no indications of undeclared nuclear materials or activities and the inspected materials and activities were in accordance with the licence holders' declarations. STUK remarked on the nuclear safeguards accountancy system and procedures of one of the stakeholders in 2012, setting required actions to comply with procedures.

Safeguards are applied to nuclear materials and activities that can lead to the proliferation of nuclear weapons or sensitive nuclear technology. These safeguards include nuclear materials accountancy, control, security and the reporting of nuclear fuel cycle related activities. The main parties involved in a state nuclear safeguards system are the facilities that use nuclear materials – often referred to as “licence holders” or “operators” – and the state authority. A licence holder shall take good care of its nuclear materials and the state authority shall provide the regulatory control to ensure that the licence holder fulfils the requirements. Also the control of non-nuclear technology holders and suppliers, to ensure the non-proliferation of sensitive technology, is a growing global challenge for all stakeholders. In the Finnish legislation all these stakeholders are dealt with as users of nuclear energy.

Finland has a significant nuclear power production, but the related nuclear industry is rather limited. Most of the declared nuclear materials (uranium, plutonium) in Finland reside at the nuclear power plants in Olkiluoto and Loviisa. Additionally, there are the VTT research reactor in Espoo and a dozen minor nuclear material holders in Finland. Nuclear dual-use items and instrumentation for the third reactor under construction at the Olkiluoto site are being imported and installed. The import licences are reviewed as applicable to ensure the peaceful use of the technology. The International Atomic Energy Agency (IAEA) and the European Commission made their site visits to the construction site prior to the installation of safeguards instrumentation and fuel delivery.

The construction of the fourth reactor at the Olkiluoto power plant and at a new nuclear power plant site Hanhikivi in Pyhäjoki, were authorised in 2010. The safeguards systems for these new reactors shall be designed together with facility design. In order to familiarise operators' staff with the safeguards needs, the second general course for operators' safeguards staff was arranged in March 2012. This continued the dialogue initiated in 2011 between the new and old operators, STUK, the Commission and the

IAEA to facilitate safeguards approaches at the new facilities. Similarly to the Olkiluoto 3 reactor, the import licences for the new facilities are reviewed as applicable to ensure the peaceful use of the technology and sensitive information. Two meetings with the operators and the ministries responsible for import and export control were arranged in 2012.

The first IAEA inspections at the new material balance areas in the front end of the nuclear fuel cycle were carried out in 2012. Uranium may be economically extracted at the Talvivaara mine as one of the by-products of nickel, because the bioheapleaching technique developed for large nickel deposits makes the extraction of other metals from low grade ore economically viable. Currently, uranium residuals are extracted from the nickel at Harjavalta nickel refinery. Industrial scale mineral processing may start in 2013 after the nuclear licensing of the Talvivaara mine.

STUK maintains a central national nuclear materials accountancy system and verifies that nuclear activities in Finland are carried out in accordance with the Finnish Nuclear Energy Act and Decree, the European Union's legislation and international agreements. These tasks are performed to guarantee that Finland can assure itself and the international community of the absence of undeclared nuclear activities and materials. In addition to this, the IAEA evaluates the success of the state safeguards system and the European Commission participates in safeguarding the materials under its jurisdiction.

The number of the routine inspection days of the international inspectorates has been reduced significantly due to the state-level integrated safeguards approach for Finland, which is in force since 2008. The number of international inspection days per year is approximately 20. Neither the IAEA nor the Commission made any remarks nor did they present any required actions based on their inspections during 2012. By their nuclear materials accountancy and control systems, all licence holders enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards. STUK continues with 40 annual inspections and more than 60 inspections days.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is one of the elements of the global nuclear non-proliferation effort. STUK has two roles in relation to the CTBT: STUK operates the Finnish National Data Centre (FiNDC) and one of the radionuclide laboratories (RL07) in the CTBT International Monitoring Network (IMS). The main task of the FiNDC is to inspect data received from the International Monitoring System and to inform the national authority, the Ministry for Foreign Affairs, about any indications of a nuclear weapons test. The FiNDC falls under the non-proliferation process in STUK's organisation, together with the regulatory control of nuclear materials.

A major goal of all current CTBT related activities is the entry into force of the CTBT itself. An important prerequisite for such positive political action is that the verification system of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is functioning and able to provide assurance to all parties that it is impossible to make a clandestine nuclear test without getting detected. The FiNDC is committed to its own role in the common endeavour so that the verification system of the CTBTO can accomplish its detection task.

The human resources development at the Nuclear Materials Section during 2012 was focused on nuclear materials control, in particular in the back end of the fuel cycle. This was partly due to the need to regulate the construction of the final disposal facility for spent nuclear fuel at the Olkiluoto repository site. The application for the licence for the disposal facility, which consists of the encapsulation plant and the geological repository, was submitted in 2012 to the Government. In addition, STUK contributed to educational workshops and training courses for authorities who represent nuclear newcomers: countries that aim at uranium production or nuclear power in co-operation with the IAEA. STUK and the Finnish Customs continued the joint multi-year border monitoring development project. The project covers customs officers training and the updating of technical equipment and of operational procedures.

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# 1 Nuclear non-proliferation implementation in Finland

Nuclear non-proliferation is a prerequisite for the peaceful use of nuclear materials and nuclear energy, globally. In order for Finland to have a nuclear industry, most of which consists of nuclear energy production, it must be ensured that nuclear materials, equipment, and technology are used only for their declared, peaceful purposes. The basis for nuclear safeguards is the national system for the regulatory control of nuclear materials and activities. Nuclear safeguards are an integral part of nuclear safety and nuclear security and they are applied both to large and medium-size nuclear industry and to small-scale nuclear material activities. Along with the safeguards, the regulatory process for nuclear non-proliferation includes transport control, export control, border control, international cooperation and conventions, and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

In Finland, STUK is the competent authority regarding the implementation of nuclear non-proliferation. In 2012 the regulatory framework for nuclear and radiation safety was reviewed by an Integrated Regulatory Review Service (IRRS) mission of the International Atomic Energy Agency (IAEA). The IRRS review was ordered by the Ministry of Employment and the Economy (MEE). The review recommendations guided also the new Director General of STUK, Mr. Tero Varjoranta, appointed for the 7 year period beginning from 1 February 2012. After the IRRS review, on 30 November 2012, a new STUK strategy for the period of 2013 – 2017 was announced. The new strategy will not affect much the mandatory implementation of non-proliferation control at STUK, but it gives a good framework for the interaction between nuclear safety, security and safeguards. In parallel

to this, STUK regulations are under renovation and are scheduled to be issued during 2013. In the new STUK safeguards regulation, the requirements concerning nuclear material accountancy, safeguards procedures and the implementation of the Additional Protocol will be merged in one updated regulation. This will instruct all stakeholders in the Finnish nuclear field on how to comply with the current national and international safeguards regulations.

## 1.1 International safeguards agreements and national legislation

Nuclear safeguards are based on international agreements, the most important and extensive of which is the Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT). The Treaty Establishing the European Atomic Energy Community (Euratom Treaty) is the basis for the nuclear safeguards system of the European Union (EU). Finland is bound by both of these treaties, and also has several bilateral agreements in the area of peaceful use of nuclear energy. When Finland joined the EU, the bilateral agreements with Australia, Canada and the USA were partly substituted by the corresponding Euratom agreements (see Appendix 3 for the relevant legislation).

Finland was the first state where an INFCIRC<sup>1</sup>/153-type nuclear Safeguards Agreement with the IAEA entered into force (INFCIRC/155, 9 February 1972). When Finland joined the EU (1 January 1995), this agreement was suspended and subsequently the Safeguards Agreement between the non-nuclear weapon Member States of the EU, the Euratom, and the IAEA (INFCIRC/193)

<sup>1</sup> INFCIRC = IAEA Information Circulars

entered into force in Finland, on 1 October 1995. Finland signed the Additional Protocol (AP) to the INFCIRC/193 in Vienna on 22 September 1998, with the other EU Member States, and ratified it on 8 August 2000. The Additional Protocol entered into force on 30 April 2004, when all the EU Member States had ratified it. The scope and mandate for Euratom nuclear safeguards are defined in the European Commission Regulation No. 302/2005.

After Finland joined EU as a Member State, and therefore joined the Euratom nuclear safeguards, a comprehensive national safeguards system was still maintained. The basic motivation for this is the responsibility assumed by Finland for its nuclear safeguards and nuclear security under the obligations of the NPT.

The national nuclear safeguards derive their mandate and scope from the Finnish Nuclear Energy Act and Decree. These were amended during 2008 as a result of the general constitution-based renewal of the Finnish nuclear legislation system. The operator's obligation to have a nuclear material accountancy system and the right of STUK to oversee the planning and generation of design information for new facilities was introduced from STUK regulations to the Decree.

As stipulated by the Act, STUK issues detailed regulations on safety and security (the YVL Guides) that apply to the use of nuclear energy. The YVL Guides most relevant to nuclear safeguards are:

- Control of nuclear fuel and other nuclear materials required in the operation of nuclear power plants (Guide YVL 6.1)
- The national system of accounting for and control of nuclear materials (Guide YVL 6.9)
- Reports to be submitted on nuclear materials (Guide YVL 6.10).

All STUK YVL Guides are under renovation. The guides relevant to safeguards shall be merged into one joint new guide. The draft version has already been communicated to the stakeholders. The new guides shall be issued by the end of 2012.

Nuclear materials control applies to:

- nuclear material (special fissionable material and source material)
- nuclear dual use items (non-nuclear materials, components, equipment and data suitable for producing nuclear energy or nuclear weapons as specified in INFCIRC/254, Part 1)
- licence holders' activities, expertise, preparedness and competence
- R&D activities related to the nuclear fuel cycle
- nuclear security, and
- safeguards for the final disposal of spent nuclear fuel.

## 1.2 Parties of the Finnish nuclear safeguards system

The main parties involved in the Finnish nuclear safeguards system are the authorities and the licence holders. Undistributed responsibility for the safety, security and safeguards of the use of nuclear energy is on the licence holder. It is the responsibility of STUK as the competent state authority to ensure that the licence holders comply with the requirements of the law and the nuclear safeguards agreements. To complement the national effort, international control is necessary to demonstrate credibility and the proper functioning of the national safeguards system.

### 1.2.1 Ministries

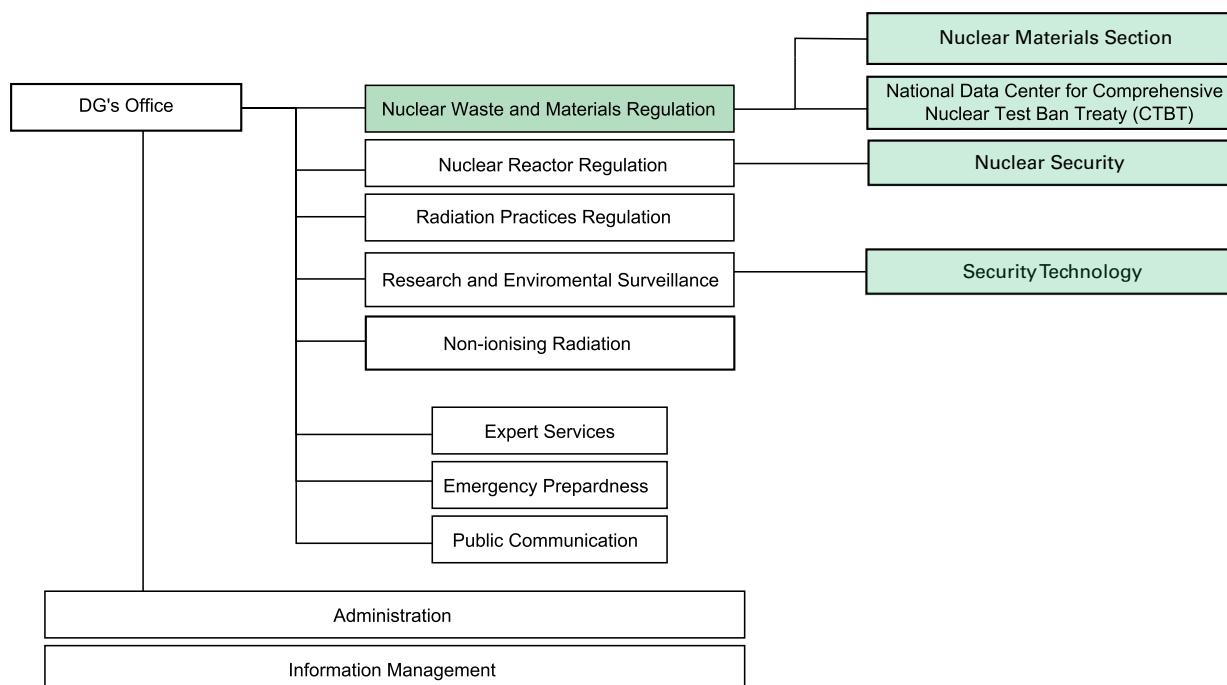
The Ministry for Foreign Affairs (MFA) is responsible for national non-proliferation policy and international agreements. The MFA is responsible for the export licensing of nuclear materials and other nuclear dual use items including sensitive nuclear technology. The Ministry of Employment and the Economy (MEE) is the highest authority for the management and control of nuclear energy. MEE is responsible for the legislation related to nuclear energy and it is also the competent authority mentioned in the Euratom Treaty. Also other ministries, such as the Ministry of the Interior and the Ministry of Defence contribute to the efficient functioning of the national nuclear safeguards system.

## 1.2.2 STUK

As per the Finnish nuclear legislation, STUK is responsible for maintaining the national nuclear safeguards system in order to prevent the proliferation of nuclear weapons. STUK regulates the licence holders' activities and ensures that the obligations of international agreements concerning the peaceful use of nuclear materials are met. Regulatory control by STUK includes the possession, use, production, transfer (national and international), handling, storage, transport, export and import of nuclear materials and nuclear dual use items. STUK is in charge of Finland's approval and consultation process for IAEA and European Commission inspectors. STUK approves an inspector as long as there are no such issues related to the person in question that might adversely affect nuclear safety or security at Finnish facilities or the non-proliferation of nuclear weapons. The new inspector requests are sent for comments to the operators that hold construction or operating licences for nuclear facilities. If STUK cannot approve an

inspector, it assigns the approval process to the Ministry of Employment and the Economy.

Nuclear safeguards by the Nuclear Materials Section of STUK (see Figure 1 for the organisational chart and Figure 12 for the staff) cover all typical measures of a State System of Accounting for and Control of Nuclear Materials (SSAC), and many other activities besides. STUK reviews the licence holders' reports (operational notifications, inventory reports), inspects their accountancy, facilities and transport arrangements on site, and performs system audits. Office work constitutes 90% of the inspection effort. Most of the working hours are subject to a charge to the users of nuclear energy (see Figure 13 for the distribution of the compiled working days). STUK runs a verification programme for nuclear activities to assess the completeness and correctness of the declarations by the licence holders. Nuclear safeguards on the national level are closely linked with other functions of nuclear materials control and non-proliferation: licensing, export control, border control, transport



**Figure 1.** Several departments and independent units of STUK cooperate under the non-proliferation framework.

control, combating illicit trafficking, the physical protection of nuclear materials, and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) – all duties of the STUK Nuclear Materials Section. Nuclear safety and particularly nuclear security objectives are closely complemented by safeguards objectives. Therefore, the research, development and regulatory units in the fields of safety, security and safeguards at STUK cooperate under the non-proliferation framework.

### 1.2.3 Licence holders

The essential parts of the national nuclear safeguards system are the licence holders, in nuclear terminology often called the operators. They perform key functions of the national safeguards system: control of the authentic source data of their nuclear materials and accountancy of nuclear materials at the facility level for each of their material balance areas (MBA). Each licence holder has to operate its safeguards system in accordance with

its own nuclear materials handbook. The handbook is a part of the facility's quality system and is reviewed and approved by STUK.

With the basic technical characteristics (BTC) submitted by a licence holder as groundwork, the European Commission shall adopt particular safeguards provisions (PSP) for that licence holder. PSP are to be drawn taking into account operational and technical constraints and in close consultation with both the person or undertaking concerned and the relevant member state. Until PSP are adopted, the person or undertaking shall apply the general provisions of the Commission regulation No 302/2005.

99.8% of all nuclear materials in Finland reside at the nuclear power plants (NPP). The amounts of nuclear materials (uranium, plutonium) in Finland in 1992–2010 are presented in Figures 2 and 3.

#### Fortum (MBA WL0V)

Fortum is a partly state-owned energy company, one of the largest in the Nordic countries. Fortum

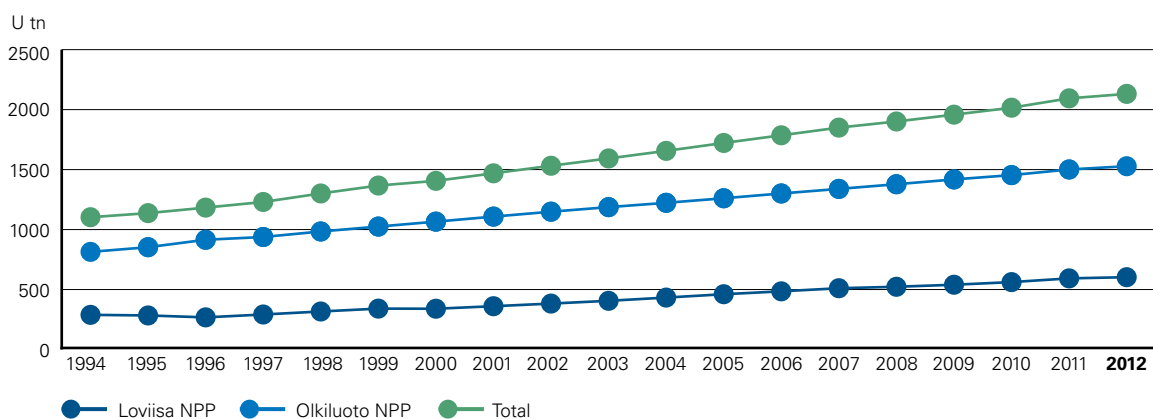


Figure 2. Uranium accumulation in Finland in 1994–2012.

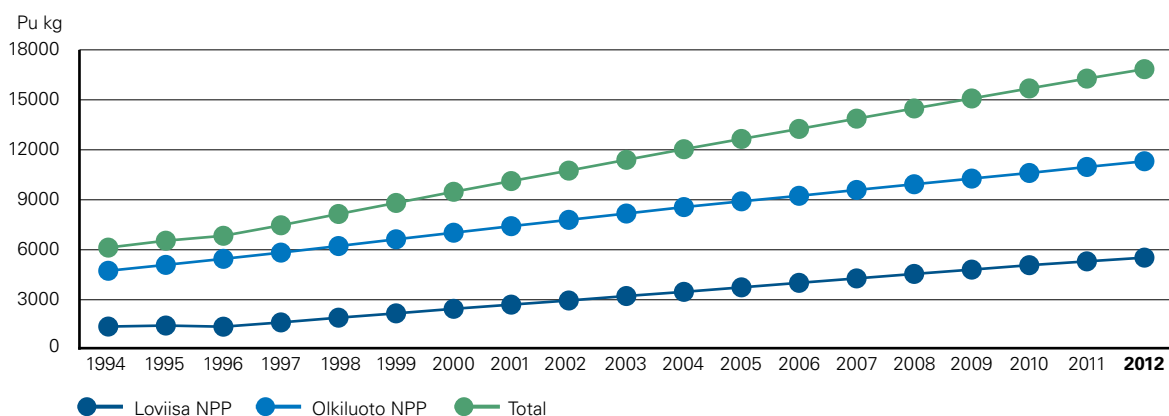


Figure 3. Plutonium in spent nuclear fuel in Finland in 1994–2012.

operates power plants of several types, nuclear among others.

The nuclear power plant of Fortum Power and Heat is located on the Håstholmen Island in Loviisa on the south-east coast of Finland. This first NPP to have been built in Finland hosts two power reactor units: Loviisa 1 and Loviisa 2. Loviisa 1 started its electricity production in 1977 and Loviisa 2 in 1980. These two units share common fresh and spent fuel storages and for nuclear safeguards accountancy purposes the whole NPP is counted as one material balance area (MBA code WL0V). The electricity generated by the Loviisa NPP constitutes circa 10% of the whole electricity production in Finland.

Most of the fuel for the Loviisa NPP has been imported from the Soviet Union / Russian Federation. The spent fuel of the Loviisa NPP was returned to the Soviet Union / Russian Federation until 1996 and since then the spent fuel has been stored in the interim storage due to a change in the Finnish nuclear legislation, which today forbids, in general, the import and export of nuclear waste including spent fuel.

The Loviisa NPP site (SSFLOV1), as per the requirements of the Additional Protocol, comprises the entire Håstholmen Island and extends to the main gate on the continent. Particular Safeguards Provisions for the Loviisa NPP, which define the European Commission's nuclear safeguards procedures for the facility, have been in force since 1998. The Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared for the Loviisa NPP.

### **Teollisuuden Voima (MBAs W0L1, W0L2, W0LS and W0L3)**

Teollisuuden Voima Oyj (TVO) owns and operates a nuclear power plant on the Olkiluoto Island in Eurajoki on the west coast of Finland. The Olkiluoto NPP consists of two nuclear power reactor units, Olkiluoto 1 and Olkiluoto 2, and an interim spent fuel storage. Olkiluoto 1 was connected to the electricity grid in 1978 and Olkiluoto 2 in 1980. The Olkiluoto NPP contributes circa 16% of the whole electricity production in Finland. At the Olkiluoto NPP there are three active material balance areas (MBA codes W0L1, W0L2, W0LS).

Presently, the uranium in TVO's nuclear fuel is mainly of Australian, Canadian and Russian

origin. This uranium is enriched in the Russian Federation or in the EU and the fuel assemblies are manufactured in Spain and Sweden.

The Finnish Government granted a licence for constructing a new nuclear reactor, Olkiluoto 3, on 17 February 2005. As a part of the licensing process, TVO's plan for arranging the necessary measures for preventing the proliferation of nuclear weapons was approved by STUK. The construction and assembly work of the reactor unit is under way. The European Commission has assigned the MBA code W0L3 for Olkiluoto 3. The initial criticality of the reactor is scheduled for 2014.

New nuclear facilities were granted by the Government on 6 May 2010. One of these was the Olkiluoto 4 reactor. The geotechnical site characterisation works at the Olkiluoto 4 site began immediately in 2010. The selection of the vendor and the supply organisation shall take place in the near future. Although the reactor type has not been specified yet, TVO submitted the preliminary basic technical characteristics (BTC) in November 2012 in order to obtain the MBA code W0L4 for future correspondence.

TVO owns most of the area of the Olkiluoto Island, but the NPP site (SSFOLK1), as per the requirements of the Additional Protocol, comprises currently the fenced areas around the reactor units, the spent fuel storage and the storage for low and intermediate level waste as well as the Olkiluoto 3 construction site. Particular Safeguards Provisions for the Olkiluoto NPP have been in force since 2007. The Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared for the Olkiluoto NPP.

### **VTT FiR1 research reactor (MBA WRRF)**

Small amounts of nuclear materials are located at facilities other than nuclear power plants. The most significant of those facilities is the VTT research reactor FiR1 (MBA code WRRF), located in Otaniemi, Espoo. The research reactor was the first nuclear reactor built in Finland at the Technical Research Centre of Finland (VTT). It reached criticality on 27 March 1962. On 12 July 2012 the Ministry of Employment and the Economy and VTT announced the plan to close down the reactor and to start the actions needed for decommissioning.

Particular Safeguards Provisions that define

the European Commission's nuclear safeguards procedures for the facility have been in force for VTT FiR1 from 1998. The Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared for the research reactor.

The VTT FiR1 site (SSFVTT1), as per the requirements of the Additional Protocol, consists of the whole building around the research reactor, although there are non-nuclear companies and university premises in the same building.

### **STUK (MBA WFRS)**

Small quantities of nuclear materials are stored by the Finnish Radiation and Nuclear Safety Authority (STUK), mainly materials no longer in use and hence taken into STUK's custody. STUK was founded in 1958 and is located at its current premises in Roihupelto, Helsinki since 1994. The STUK MBA (WFRS) consists of the STUK headquarters and the "Central interim storage for small-user radioactive waste" at the Olkiluoto NPP site.

The STUK site (SSFSTUK), as per the requirements of the Additional Protocol, consists of the whole building where STUK's headquarters are located in Helsinki, but non-STUK premises in the building are excluded. The storage at Olkiluoto is included in the NPP's site declaration.

### **The University of Helsinki, Laboratory of Radiochemistry (MBA WHEL)**

The Laboratory of Radiochemistry at the University of Helsinki (HYRL) uses small amounts of nuclear materials. HYRL is located at the Kumpula university campus in Helsinki.

The HYRL site (SSFHYRL), as per the requirements of the Additional Protocol, comprises the whole building that hosts the laboratory.

### **OM Group Kokkola Chemicals (MBA WKK0)**

The OM Group (OMG) Kokkola Chemicals facility does not use nuclear materials as such. However, the by-products of their cobalt purification process contain uranium, which qualifies these by-products as nuclear material. OMG Kokkola Chemicals has an operation licence for producing, storing and handling nuclear material. OMG Kokkola Chemicals is located on the west coast of Finland.

### **Norilsk Nickel Harjavalta (MBA WNNH)**

Norilsk Nickel operates the nickel refining plant at Harjavalta in western Finland. The plant was commissioned in 1959, expanded in 1995 and again in 2002. Norilsk Nickel Finland became a part of the Russian-based Norilsk Nickel as a result of the OM Group's nickel business acquisition in 2007. Norilsk Nickel's Harjavalta refinery employs a technique of sulphuric acid leaching of nickel products. The uranium residuals will be extracted from the nickel products from the Talvivaara mine. In March 2010 STUK granted a licence to extract less than 10 tons of uranium per year. The Norilsk Nickel company submitted the basic technical characteristics (BTC) to the European Commission in December 2010.

### **Other nuclear material holders**

There are about ten minor nuclear material holders in Finland. One of them is an actual material balance area: the University of Jyväskylä, Department of Physics (JYFL, MBA code WDPJ), but in fact the nuclear material at JYFL has been derogated and exempted by the European Commission and the IAEA. Other minor nuclear material holders are members of a Catch-All-MBA (CAM), for the purposes of international nuclear safeguards. Most of these have depleted uranium as radiation shielding material.

### **New operators**

The Talvivaara Sotkamo Ltd. mining company announced on 9 February 2010 its interest in investigating the recovery of uranium as a separate product from its sulphide ore body. The Talvivaara deposits in eastern Finland comprise one of the largest known sulphide nickel resources in Europe. The bioheapleaching technique developed for the deposits makes the extraction of metals from low grade ore economically viable. Therefore, in addition to nickel, zinc, copper and cobalt also uranium may be economically extracted and processed at the site. The company has submitted licence applications in accordance with the mining and nuclear energy legislation in order to recover uranium. The Basic Technical Characteristics (BTC) was submitted to the European Commission in 2010, and the MBA code WTAL is assigned for the future ura-



nium extraction plant. The environmental impact assessment was carried out in 2010. The production of uranium is expected to start during 2013 if all the relevant licences are granted.

The Fennovoima company announced on 5 October 2011 its decision to locate their new nuclear power plant on the Hanhikivi peninsula at Pyhäjoki, located on the coast of the Bay of Bothnia. Fennovoima is doing preparatory works with vendor candidates. In 2011 Fennovoima submitted bid invitations to Areva and Toshiba and the bids were received in January 2012. Fennovoima will select the plant supplier in 2013. The construction licence application is expected to be submitted within five years after the ratification of the Decision-in-Principle in summer 2010. The Hanhikivi site shall be declared as the construction proceeds from a virgin green site to the nuclear power plant.

### Posiva (MBA WOLF)

Posiva Oy is the company responsible for the final disposal of spent nuclear fuel in Finland. It is owned by TVO and Fortum. Posiva has been excavating an underground rock characterisation facility called “Onkalo” in Eurajoki since 2004, and thus preparing for the construction of the final disposal facility. While neither a nuclear licence holder nor a nuclear material holder yet, Posiva and its activities are highly relevant to the national safeguards system because Posiva is foreseen to develop a new type of facility, the geological repository, where the nuclear material cannot be re-verified once it has been encapsulated and emplaced. In the IAEA safeguards approaches it has been suggested that the geological formation should be under safeguards during the whole lifetime of the underground facility. Therefore, Posiva has been required to develop a non-proliferation handbook, such as a nuclear materials handbook, to describe Posiva’s safeguards procedures and reporting system already before becoming a nuclear material holder. The preliminary basic technical characteristics (BTC) have been provided and the European Commission has already assigned the MBA code WOLF for Onkalo. The facility without nuclear materials but having the BTC constitutes a site according to the Additional Protocol. The Posiva site (SSFPOS1) covers the fenced area around the buildings supporting the repository construction. By the end of 2012, Posiva submitted to

the Government an application to construct the final disposal facility, which will consist of the encapsulation plant and the geological repository.

### Other stakeholders

Non-nuclear technology holders and suppliers that serve nuclear and other industry are obliged to take care that non-proliferation sensitive technology does not get into the hands of unauthorized non-state actors and thereby contribute to nuclear proliferation. The introduction of the Additional Protocol (1996) extended the scope of safeguards to the non-proliferation control of nuclear programmes and fuel cycle related activities in Member States around the world. Additionally, the United Nations Security Council Resolution 1540 (April 2004) requires every State to ensure that export controls, border controls, material accountancy and physical protection are efficiently taken care of and calls all States to develop appropriate ways to work with and inform industry and the public regarding their obligations. The control of non-nuclear technology holders and suppliers to ensure the non-proliferation and peaceful use of sensitive technology and dual-use items is a growing global challenge for all stakeholders.

Nuclear safeguards are commonly seen as the traditional nuclear material accountancy and reporting system, the main stakeholders of which are the international, regional and local authorities, and the operators. In accordance with the extended non-proliferation regime and the amendments to the Finnish legislation, the companies that have activities defined in the Additional Protocol or have customers for dual-use equipment abroad are under strengthened reporting requirements and export control.

## 1.3 IAEA and Euratom safeguards in Finland

The IAEA and the European Commission nuclear safeguards both have their separate mandates to operate in Finland. These two international inspectorates have agreed on cooperation, which aims to reduce undue duplication of effort. Year 2009 introduced a significant change from the traditional safeguards procedures in Finland as the implementation of integrated safeguards began on 15 October 2008.



**IAEA regular inspections:***Facilities at nuclear power plants (NPP):*

- *Physical Inventory Verification (PIV) / Design Information Verification (DIV) 1/year*
- *Random Interim Inspection (RII) at 48 h notification (at least 1/year)*

*Spent fuel storages at NPPs*

- *PIV/DIV 1/year*
- *RII at 2h i.e. Unannounced Inspection (UI)/48 h notification (at least 1/year)*

*Research reactor and locations outside facilities (LOF)*

- *PIV/DIV 1/4–6 years*

*New reactors, under construction*

- *DIV and PIV later like at the NPPs*

*Repository (Onkalo), under construction*

- *PIV/DIV most likely as at spent fuel storages*

*Complementary accesses at 2/24 h notification to verify declared activities or to detect undeclared activities.*

Integrated safeguards include traditional nuclear safeguards as per INFCIRC/193, and safeguards activities in accordance with the Additional Protocol, fitted together. While this should not lead to an increase in inspections, it should enable the IAEA to assure itself of the absence of undeclared nuclear activities in a state. In practice, the number of IAEA routine interim inspections decreases. In contrast to this, the IAEA will additionally perform 1–3 unannounced or short notice inspections per year in a state that has a number and type of nuclear installations that resembles the situation in Finland.

The operators report to the Commission as required per Commission Safeguards regulation No 302/2005. It is the Commission's task to audit the licence holders' accounting and reporting systems. Both the Commission and STUK have increased preparedness for short notice and unannounced inspections and complementary access (abbreviated SNUICA). Every weekday, one of STUK's inspectors is prepared to attend a possible IAEA inspection.

The number of IAEA and Euratom routine inspections decreased significantly in 2009, as

defined in the state-level safeguards approach for Finland, which was negotiated during 2007 and 2008. The time difference between the unannounced inspections at the two spent fuel storages (i.e. 2 hours for Loviisa and 48 hours for Olkiluoto) was due to the difference in the surveillance at the storages and reasonable access time for a STUK inspector. STUK continues with annual routines with approximately 40 inspections, which enables the reduction in the effort of the international inspectorates.

## 1.4 Verified declarations for state evaluations

A state's declarations on its nuclear materials and activities are the basis for the state evaluation by the IAEA under the obligations of the Additional Protocol. In Finland, the state has delegated its responsibility for these declarations to STUK. STUK has been nominated a site representative, as per European Commission regulation No 302/2005. STUK collects, inspects and reviews the relevant information and then submits the compiled declarations timely to the Commission and the IAEA.

In Finland, there are currently six sites in the sense of the Additional Protocol: the two nuclear power plant (NPP) sites in Loviisa and Olkiluoto respectively, the geological repository site in Olkiluoto, and three minor sites: the Technical Research Centre of Finland (VTT), the Radiation and Nuclear Safety Authority (STUK) and the Laboratory of Radiochemistry at the University of Helsinki (HYRL). STUK reviews and verifies the correctness and completeness of the information about the sites provided by the stakeholders.

STUK reviews annually the information about research and development activities that might be eligible for declaration, as well as activities specified in Annex I of the Additional Protocol. STUK maintains the information on general plans related to the nuclear fuel cycle for the next 10 years and keeps account of the exports of specified equipment and non-nuclear materials, as listed in Annex II of the Additional Protocol.

Technical analysis methods are one tool for a state nuclear safeguards system to ensure that nuclear materials and activities within the state are in accordance with the licence holders' declarations and that there are no undeclared activities. Such methods can provide information on the identity

of the nuclear materials and confirm that licence holders' declarations are correct and complete with respect to e.g. the enrichment of uranium, the burnup, and the cooling time of nuclear fuel. The technical analysis methods in use are non-destructive assay (NDA), environmental sampling and satellite imagery.

STUK employs three NDA methods for verifying spent nuclear fuel. One method lends itself for rapid scanning, as the detector is mounted on the fuel transfer machine and the fuel elements can be measured from above the fuel pond without moving the elements. The other two methods, on the other hand, allow confirming with greater confidence the correctness of the declared burnup and the cooling time. With the most precise method, the absence of a fuel pin or pins from a fuel element can be discovered. STUK reports to the Commission and the IAEA about the NDA measurement campaigns.

All nuclear materials leave traces of their identity, source of origin and treatment. Safeguards environmental samples (ES) are used to investigate these traces, which provide further information for establishing whether the nuclear activities are in accordance with the declarations. In the Finnish nuclear safeguards system environmental samples are collected as surface swipes. The IAEA may collect independent environmental samples during its complementary access type of inspections.

Satellite imagery is applied to verify the site declaration in accordance with the Additional Protocol. Timely imagery is used to monitor different kinds of activities at the sites or elsewhere in Finland. STUK contributes to the work of the satellite image analysts of the IAEA and the Commission.

## 1.5 Export/import control and licensing as elements of nuclear non-proliferation

As per the Finnish Nuclear Energy Act, in addition to nuclear materials also other nuclear fuel cycle related activities are under regulatory control. A licence is required for the possession, transfer and import of components, equipment, materials and technology suitable for producing nuclear energy (nuclear dual use items).

The list of these other items is based on the Nuclear Suppliers' Group (NSG) Guidelines (INFCIRC/254 Part 1). The licence holder is re-

quired to provide STUK with a list of the above mentioned items annually. Moreover, the export, import, and transfer of such items shall be reported to STUK.

Mining and mineral processing operations that aim to produce uranium or thorium are also under nuclear safeguards and regulatory nuclear safety control. In order to carry out these activities a national licence and an accounting system to keep track of the amounts of uranium and thorium are required. A national licence is also required to export and import uranium or thorium ore, and these activities are to be authorised by the Euratom Supply Agency and the European Commission. These mining and milling activities and production shall be reported to STUK, the Commission and to the IAEA.

Finland's export control system is based on the EU Council Regulation (EC) No 428/2009 of 5 May 2009, which sets up a Community regime for the control of exports, transfer, brokering and transit of dual-use items. The export of Nuclear Suppliers' Group (NSG) Part 1 and Part 2 items is regulated by the Finnish Act on the Control of Exports of Dual Use Goods. The licensing authority is the Ministry for Foreign Affairs. An authorisation is required to export nuclear items outside the European Union. A licence is also required for EU internal transfers of NSG Part 1 items, excluding non-sensitive nuclear materials.

## 1.6 The regulatory control of transport covers nuclear materials

The requirements for the transport of radioactive material are set in the Finnish regulations on the transport of dangerous goods. The requirements are based on the IAEA safety standard Regulations for the Safe Transport of Radioactive Material, SSR-6, and their purpose is to protect people, the environment and property from the harmful effects of radiation during transports of radioactive material. Based on these regulations, STUK is the competent national authority for the regulatory control regarding the transport of radioactive material.

In addition to the dangerous goods transport regulations, the Finnish Nuclear Energy Act sets specific requirements for the transport of nuclear material and nuclear waste: generally a licence granted by STUK is needed for such a transport. Usually the transport licences are granted for a

fixed period, typically for a few years. A transport plan and a transport security plan approved by STUK are mandatory for each transport of nuclear material or nuclear waste. A certificate of nuclear liability insurance shall also be delivered to STUK before the transport. Furthermore, a package may be used for the transport of fissile nuclear material only after the package design has been approved by STUK.

### 1.7 STUK's contribution to international safeguards development

Nuclear non-proliferation is, by its nature, an international domain. STUK therefore actively participates in international nuclear safeguards related cooperation and development efforts.

STUK is a member of the European Safeguards Research and Development Association (ESARDA), and has nominated Finnish experts to its committees and most of the working groups. STUK participates in the ESARDA Executive Board meetings and in several working groups.

Upon request by the IAEA, STUK's experts have contributed to the IAEA's international missions. The current experience obtained from the planning, design and construction of new nuclear facilities in Finland has increased the number of requests to participate in different kinds of international co-operation.

STUK keeps close contacts with the respective Nordic authority organisations. The development of the final disposal of spent nuclear fuel in geological repositories deepens the cooperation between Finland and Sweden.

The Finnish Safeguards Support Programme

to the IAEA Safeguards, FINSP, was established in 1988. The aim of the FINSP is to provide the IAEA with educational and technical support in the field of non-proliferation of nuclear weapons. The FINSP is funded by the Ministry for Foreign Affairs and implemented by STUK.

### 1.8 The Comprehensive Nuclear-Test-Ban Treaty

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an important part of the international regime for the non-proliferation of nuclear weapons. The CTBT bans any nuclear test explosions in any environment. This ban is aimed at constraining the development and qualitative improvement of nuclear weapons, including also the development of advanced new types of nuclear weapons.

The CTBT was adopted by the United Nations General Assembly, and was opened for signature in New York on 24 September 1996. The CTBT will enter into force after it has been ratified by the 44 states listed in its Annex 2. These 44 states participated in the 1996 session of the Conference on Disarmament and possess nuclear power or research reactors. On 12 February 2012 Indonesia ratified the CTBT, bringing the number of missing Annex 2 state ratifications down to eight.

A global verification regime is being established in order to monitor compliance with the CTBT. The verification regime consists of the following elements: the International Monitoring System (IMS), a consultation and clarification process, on-site inspections and confidence-building measures.

Finland signed the CTBT on its day of opening in 1996 and ratified it less than three years later.

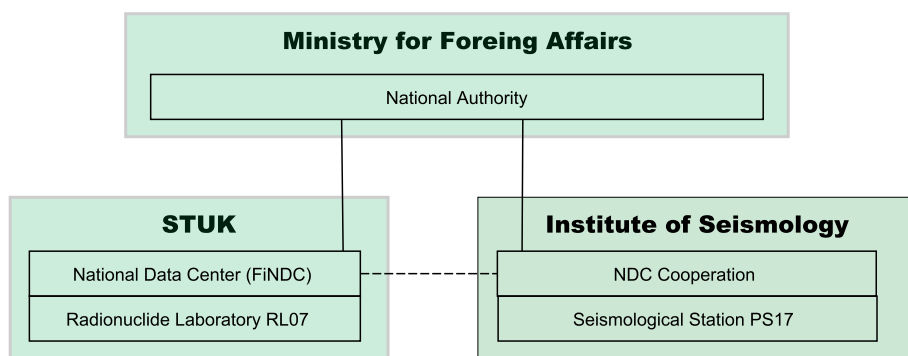


Figure 4. The Finnish CTBT organisation.

### ***Comprehensive Nuclear-Test-Ban Treaty (CTBT) Status (31 December 2012)***

- *CTBT Member States* 183
- *Total Ratifications* 157
- *Annex 2 Ratifications* 36

In addition to complying with the basic requirement of the CTBT of not to carry out any nuclear weapons tests, Finland actively takes part in the development of the verification regime.

In the CTBT framework, the Finnish national authority is the Ministry for Foreign Affairs. STUK has two roles: STUK operates the Finnish National Data Centre (FiNDC) and one of the sixteen radionuclide laboratories in the IMS (RL07). The most important task of the FiNDC is to inspect data received from the IMS and inform the national authority about any indications of a nuclear test explosion. The radionuclide laboratory contributes to the IMS by providing support in the radionuclide analyses and in the quality control of the radionuclide station network. The third major national collaborator is the Institute of Seismology at the University of Helsinki, which runs an IMS seismology station (PS17 in Lahti), and provides analysis of waveform IMS data (Figure 4).

## **1.9 Nuclear safeguards and security**

STUK is the national authority for the regulatory control of nuclear and radiological safety, security and safeguards. All these three regimes have a common goal: the protection of people, the society, the environment, and future generations from the harmful effects of ionising radiation. As nuclear security aims to protect nuclear facilities, nuclear material and other radioactive material from unlawful activities, it is clear that the majority of the activities that aim at non-proliferation of nuclear weapons, nuclear materials and sensitive nuclear technology contribute to nuclear security. Physical and information security measures at nuclear facilities and for nuclear materials contribute also

to non-proliferation by providing detection and delay of and response to security events. On the other hand, nuclear material accountancy and control measures may supplement security measures through a deterrence effect. Within STUK's organisation, some of its nuclear security related tasks fall – solely or partly – under the duties of the nuclear non-proliferation process and the Nuclear Materials Section:

- national system for the control of nuclear materials and nuclear dual use items; the system facilitates international nuclear safeguards activities in Finland
- regulatory control of the transport of nuclear materials and nuclear waste
- import and export control
- advice to the Finnish Customs on radiation monitoring at the borders, in concept development and technical specifications; training for Customs officers
- participation in the work of the international nuclear safeguards and nuclear security communities and working groups (IAEA, ESARDA, AQQ, ITWG...)
- participation in STUK's response in cases of radiological or nuclear incidents
- advice to the Finnish Customs on the interpretation of radiation detections at borders, more sophisticated on-site measurements and analyses in response to border monitoring alarms

The Finnish regulatory system for nuclear security was audited by an IPPAS mission in 2009, followed by an IPPAS follow-up mission in 2012. One of the recommendations arising from the audit, namely the need for more detailed security requirements for minor holders of nuclear materials, was in the Nuclear Materials Section's area of responsibility. As a result, the new YVL Guide for nuclear materials control, under review since 2010 and expected to come into force in 2013, will contain more detailed security requirements for these minor holders.

## 2 Theme of the year 2012: new facilities

### 2.1 Bidding for new facilities

The preparatory work for the future power plants and the experience obtained from the continuing construction of the Olkiluoto 3 nuclear power plant have given STUK experience that is in the interest of the whole international nuclear community. Although the applicants for new power plants are requested to submit their nuclear construction licence applications within 5 years, the bidding phase of the new projects has pointed out the need to have regulations and control of nuclear technology and related restricted information in place already before the licensing of the future operator. In order to clarify the needs of the operators, STUK arranged two workshops between the operators and authorities, including both the Ministry for Foreign Affairs (MFA) and the Ministry of Employment and the Economy (MEE). In particular, the Olkiluoto 3 construction project has given practical experience of import and export licensing procedures and the control of nuclear technology. In 2012 STUK issued 16 licences for the import, possession and/or transfer of nuclear technology.

### 2.2 Safeguards, security and safety in design

As a consequence of the 2010 Parliament authorisation of the three new nuclear facilities, STUK initiated negotiation with the operators, the European Commission and the International Atomic Energy Agency (IAEA) to prepare for the implementation of safeguards timely with the facility development in 2011. A second course on the implementation of safeguards was arranged at Helmiranta, near the Olkiluoto power plant on 28 March 2012, in close cooperation with STUK, the Commission and the IAEA under the IAEA Safeguards-by-Design initiative (Figure 5). As a consequence, safeguards and security requirements

in the design were included in an early phase of the bidding for the first time. With assistance from Finnish operators STUK experts also contributed to the IAEA symposium on safeguards-by-design in September 2012 and to the preparation of the IAEA guidance documents.

Several IAEA meetings during 2012 were focused on the interfaces and synergies of safety, security, and safeguards for nuclear newcomers – countries embarking on nuclear power programs – and countries actively building their nuclear infrastructures for expansion. It is widely acknowledged that there are known synergies as well as challenges between safety and security and between security and safeguards. It is most effective if all requirements for safety, security and safeguards are provided together during the design stage or as a part of the bid specifications to avoid separate requirements which might conflict with each others. The integration of the three S's – safety, security and safeguards – optimises the site and plant design and reduces the chance for design changes or expensive retrofitting late in the construction process.

In the meetings regarding new nuclear programmes and the import and export of nuclear information and technology, STUK and the Finnish nuclear companies have realised that every expert needs to have a basic understanding of safety, security and safeguards to maintain expertise in the nuclear field. Because the Finnish stakeholders have experience of existing nuclear power plants and also new nuclear power programmes, it has been important to find the main synergies and interfaces between safety, security and safeguards and to share this understanding with newcomer states. This is demonstrated in Figure 6 as the Finnish Support Programme to the IAEA, which arranged a one-week course for nuclear newcomer states at STUK and at the Olkiluoto facilities.



## 2.3 New STUK regulations

STUK continued with the annual meetings with the operators. Each power company was met twice and one common meeting in April 2012 was arranged at the IAEA in Vienna for all Finnish power companies. One of the topics in these meetings was preparing for the remote monitoring by the IAEA and the Commission and the data transmission that it requires, in such a manner that safety and security are not jeopardised. The status and content of the new STUK regulations were also discussed.

As a part of the extensive reformation work on the YVL guides, the safeguards requirements in former YVL 6.9 and YVL 6.10 have been compiled while also taking into account changes in safeguards since the late 1990s. New areas covered are e.g. the obligations and measures stemming from the Additional Protocol for the Safeguards Agreement and recent developments in the area. The new YVL Guide D.1 covers obligations and requirements to all users of nuclear energy in all phases of the nuclear fuel cycle. All stakeholders will have to describe their own safeguards system in written form (as a nuclear materials handbook) to ease their task of fulfilling their obligations and to guarantee the effective and comprehensive function of the national safeguards system. In the new guide there are also specific national requirements for the final disposal of spent nuclear fuel. The new YVL Guide D.1 on safeguards is scheduled to enter into force in spring 2013.



**Figure 5.** The staff of Finnish operators participated actively in the safeguards-by-design training provided by STUK, the Commission and the IAEA.

## 2.4 Decommissioning and a new building at VTT

The Technical Research Centre of Finland (VTT) made two important decisions for the Finnish nuclear community during 2012. A new building for experimental nuclear research shall be built at the Espoo premises of VTT, but on the other hand, the old nuclear material testing laboratories will be demolished and the research reactor will be closed down. Both of these decisions will have long-lasting effects, due to the need for permissions, contracts and environmental impact assessment. This affects also safeguards, as the nuclear materials have to be kept under the control of competent personnel at both facilities. Also the research and developments activities – even those not including nuclear materials and manufacturing of fuel-cycle related items – have to be under safeguards control, owing to the requirements in the Additional Protocol and possible import licence conditions and security requirements. In 2012 these decisions and future changes did not yet affect the formal declaration of VTT, because the builder, Senate Properties, a government owned enterprise responsible for managing the Finnish state's property assets, had not yet made the decision to invest in the new nuclear safety research centre. This project highlights how safeguards implementation requires continuous communication between the regulator, the operator and the other stakeholders in the nuclear fuel cycle.



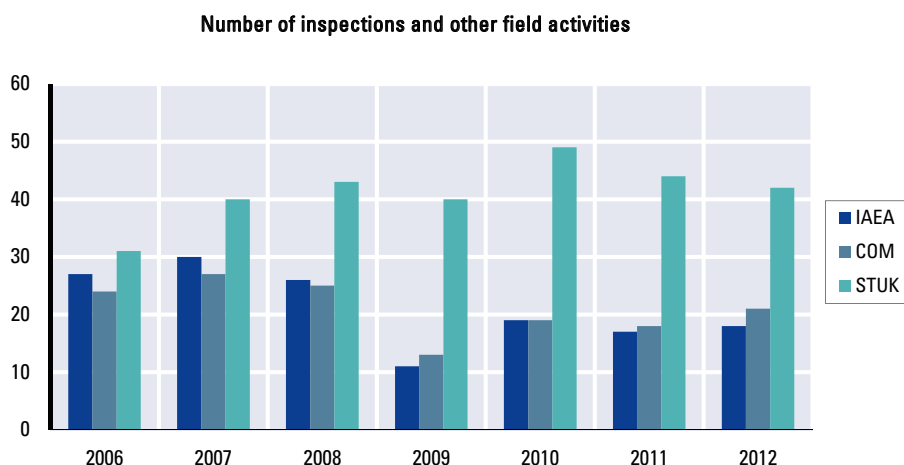
**Figure 6.** Sharing experiences about nuclear programmes in Finland with the newcomer states.

### 3 Safeguards activities in 2012

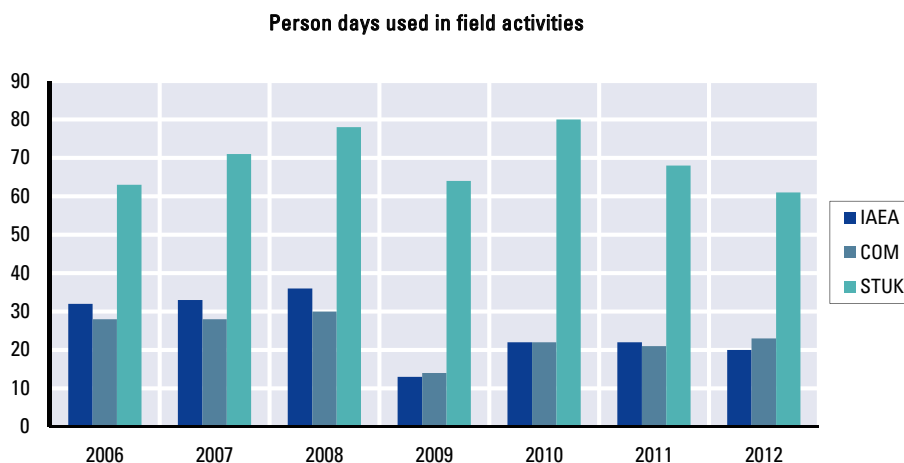
#### 3.1 The regulatory control of nuclear materials

STUK continued with national safeguards measures as in the past. Nuclear material inventories at the end of 2012 are shown in Tables 2 and 3 in Appendix 1. The development of inspections and inspection person days per Material Balance Area (MBA) is presented in Figures 7 and 8. Inspections by STUK, the International Atomic Energy Agency (IAEA) and the European Commission in 2012 are presented in Appendix 2.

The application of integrated safeguards began in Finland on 15 October 2008. Thus, in the year 2009 the number of the IAEA inspections was reduced from approximately 25 person days to 15. Similarly, the Commission reduced its inspection activities significantly. In 2010 the number of inspection days rose somewhat due to the first inspections at the geological repository site, additional inspection days at the Loviisa Nuclear Power Plant (NPP) and the increased number of random inspections in Finland. Since 2010, the number of



**Figure 7.** The number of inspections from 2006 to 2012.



**Figure 8.** Inspection person days from 2006 to 2012.

regular inspections remained at the same level, i.e. the current number of the annual IAEA inspection days is around 20 person days in Finland. In 2012 there were a few additional inspections to Loviisa NNP owing to cask transfers during the maintenance outage.

### 3.1.1 Declarations and approvals of new international inspectors

All the relevant licence holders sent their updated information for the national declaration, which is compiled by STUK, in time by 1 March 2012. STUK submitted Finland's annual declaration updates to the IAEA on 15 May 2012 as required. Additionally, STUK submitted the quarterly declarations on exports in February, May, August and November.

In 2012, altogether 15 IAEA and 12 Commission new inspectors were approved to perform inspections at nuclear facilities in Finland.

### 3.1.2 The Loviisa nuclear power plant site

In 2012, STUK approved the update of the nuclear materials hand book at Fortum's Loviisa NPP. The change of responsibilities between the person responsible for nuclear safeguards and his deputy was approved. In 2012 STUK granted the operating company Fortum one import licence for a device used in a nuclear reactor.

STUK inspected and verified the annual site declaration on 6 March 2012. The Commission joined this inspection to serve the containment and surveillance equipment and to verify the basic technical characteristics, i.e. the design information.

The refuelling and extensive maintenance outage of the Loviisa 1 reactor unit, which is to be carried out every eight years, took place in the period 5 August – 29 September 2012, and the short routine outage of the Loviisa 2 reactor unit in the period 22 September – 13 October 2012. Owing to the new integrated safeguards approach for Finland, the IAEA and the Commission performed a before Physical Inventory Taking (pre-PIT) inspection with STUK before the outage, on 1 – 12 August 2012. Temporary surveillance cameras were installed in the reactor halls for the outage period, and removed during the Physical Inventory Verification (PIV) carried out after the outage, on 30 – 31 October 2012. During the out-

age and before the closing of each reactor, STUK identified the fuel assemblies in the reactor cores and item counted the loading ponds. The Loviisa 1 core was inspected on 5 September 2012 and the Loviisa 2 core on 28 – 29 September 2012. During the outages, the cask transfer was inspected four times by the IAEA and the Commission. In addition to the PIV and the core controls, STUK carried out one routine inspection and two measurement campaigns. During the year STUK remarked the NPP on the need to maintain equipment needed to facilitate several operations, also those needed for safeguards inspections at the facility. The ageing of technology was addressed in general.

On the basis of its own assessment as well as of IAEA and Commission inspection results, STUK concluded that Fortum's Loviisa NPP has complied with its nuclear safeguards obligations in 2012.

### 3.1.3 The Olkiluoto nuclear power plant site

In 2012, STUK approved one new person to be appointed deputy for the person responsible for nuclear safeguards at the Olkiluoto NPP. During 2012 STUK also granted to TVO nine import licences, four import and possession licences, one possession licence and three transfer licences. These covered the import of fresh nuclear fuel and nuclear dual use items, i.e. technology and instrumentation for the operating units and equipment for the new unit under construction.

The operating waste repository in Olkiluoto has been used since the year 1992 for the final disposal of low and medium level nuclear waste generated at the Olkiluoto 1 and Olkiluoto 2 plant units. The operating licence expires on 31 December 2051. TVO submitted to the Government in September 2011 an application for the amendment of the terms of the operating licence of the operating waste repository. The Ministry of Employment and the Economy requested statements on the application from several different Ministries and other authorities. On 22 November 2012 the Government granted TVO a licence amendment for the final disposal of low and medium level nuclear waste from the Olkiluoto 3 plant unit under construction in the operating waste repository in Olkiluoto. Also state-owned radioactive waste, such as radiation sources used in hospitals and for educational purposes, can be emplaced in the operating waste repository in the future.



The refuelling and maintenance outage of the Olkiluoto 1 reactor unit took place in the period 24 April –11 May 2012 and that of the Olkiluoto 2 reactor unit in the period 27 May – 6 June 2012. The annual outages were brought forward due to the water leak detected in the main generator in April. Therefore, the IAEA and the Commission performed a pre-PIT inspection with STUK already on 30 April 2012, not before the outage, but before the opening of the core, which is essential for safeguards. The PIV was carried out after the outage on 12 – 14 June 2012.

During the refuelling and maintenance outage STUK identified the fuel assemblies in the reactor cores and verified and item counted the loading ponds before the reactors were closed. The Olkiluoto 1 reactor was inspected on 13 May 2012 and the Olkiluoto 2 reactor on 3 June 2012.

The IAEA short notice random interim inspection addressed to the Olkiluoto NPP: on 13 April the Olkiluoto 1 unit was inspected and on 17 October 2012 the spent fuel storage. At the time of the latter inspection, the spent fuel ponds were covered to protect the ponds from possible influence from the ongoing expansions works of the storage building. The covers of one of the ponds did not allow the access and verification of all of the seals. Thus, the verification of the seals is postponed. STUK carried out two additional routine inspections to the Olkiluoto site and the material balance areas (MBA) at the Olkiluoto NPP. The construction of the spent fuel storage enlargement restricts spent fuel transfer from the reactor buildings. This situation is expected to continue for few more years.

The construction of the new Olkiluoto 3 reactor (OL-3) has proceeded to such a stage that nuclear items are to be installed at the site. The main components are under assembly and STUK's regulatory control. TVO prepared a draft for the basic technical characteristics (BTC) of the new unit in 2008. This first BTC was reviewed by STUK, the IAEA, and the Commission twice in 2008. Thus, the inspectorates have the possibility to plan the surveillance and containment measures in advance. During 2009, future actions were waiting for the advancement of the construction of the fuel handling buildings. The IAEA and the Commission visited the OL-3 construction site on 3 March 2010, 27 April 2011 and on 6 September 2012 to adjust

containment and surveillance instrumentation on site. The principal locations of cameras and control units were agreed to for the reactor building in 2010 and for the fuel handling building in 2011. The commissioning of the OL-3 unit has been postponed several times, and the current estimate for commissioning is 2016.

The construction of the new Olkiluoto 4 reactor (OL-4) was authorised in 2010. The geotechnical works have started at the site, but the decision for the reactor type and the vendor organisation are still pending. Despite lacking these important details, TVO submitted the preliminary BTC to the Commission on 1 November 2012 and proposed the MBA code W0L4 for the new unit. This was confirmed by the Commission on 8 January 2013. The nuclear construction licence application with technical details is expected to be submitted within 5 years after the Decision-in-Principle of July 2010.

On the basis of its own assessment as well as IAEA and Commission inspection results, STUK concluded that TVO's Olkiluoto NPP has complied with its nuclear safeguards obligations in 2012, although all of the seals at the spent fuel storage could not be accessed during the latest inspection.

### 3.1.4 The Pyhäjoki nuclear power plant project

The Government approved a Decisions-in-Principle in 2010 for the new operator Fennovoima to construct a new nuclear power plant at a new site. The applicant was requested to submit their nuclear construction licence applications within 5 years and to submit a plan for its nuclear waste management within 6 years. On 5 October 2011 Fennovoima announced its decision to build the new nuclear power plant on Hanhikivi peninsula in Pyhäjoki. The facility construction may start after the licence is granted. Owing to this authorisation STUK initiated negotiations with the operators and the Commission and the IAEA in 2011 to prepare for the implementation of safeguards timely, together with the facility development. As a consequence the company could request the vendor organisations to facilitate safeguards implementation, e.g. improve proliferation resistance, nuclear material verification and surveillance at the future plant. In 2011 Fennovoima submitted bid invitations to Areva and Toshiba and the bids were received in January 2012. Fennovoima will select the plant supplier in 2013. The schedule of the whole

construction project will be specified in the plant contract. In the meanwhile Fennovoima created an organisation for safeguards and prepared for the implementation of safeguards. Their nuclear materials handbook is under preparation and the basic technical characteristics and the site declaration will be prepared and submitted after the selection of the supply organisation, reactor type and location at the site.

One of the first steps in the construction process is the control of nuclear technology, e.g., sensitive information obtained from the bidding companies. During 2012 STUK granted Fennovoima two import licences for the possession of nuclear technology. Based on the meetings on the implementation of safeguards and the control of nuclear technology with Fennovoima's staff, STUK concludes that awareness and preparedness for safeguards procedures are at an adequate level in the new organisation preparing for the new project.

### 3.1.5 The VTT FiR1 research reactor site

In 2012 STUK carried out two interim inspections to the research reactor site of the VTT research centre. The site declaration and activities and internal control systems were reviewed on 7 February 2012 March. Safeguards inspectors from STUK and the Commission verified the nuclear material inventory of VTT on 6 September 2012. There were some inconsistencies in reporting but the nuclear material inventory was concluded to be correct during the inspection. After the inspection, the reporting of small amounts and exchanges of small samples between research organisations on the Otaniemi University Campus was addressed by STUK and the Commission.

VTT submitted the operating licence application to the Government on 30 November 2010. During the handling process of the operating licence application, there was a special focus on ensuring that the continued use of the research reactor meets specific safety requirements. In its statement on 30 October 2011 STUK commented also the need for competences for the whole licensed period. On 8 December 2011, the Government granted the operating licence for VTT research reactor FiR 1, until the end of 2023. However, in the beginning of 2012 commercial medical use of the reactor met with financial difficulties; and moreover, on 12 July 2012 the Ministry of Employment and the Economy and

VTT announced that the research reactor will be closed down and preparatory works required for decommissioning will take place. On 4 December 2012 STUK and VTT's responsible persons met and discussed future actions to ensure appropriate safeguards procedures for the future. As a consequence, the joint nuclear history of the university and the research centre in Otaniemi, and the current possession and location of old reactor fuel including reactor graphite were reviewed.

### 3.1.6 The STUK site

Owing to outsourcing of staff and activities at the national waste receiving station of STUK, the responsibilities and boundaries at the operator were not clearly indicated since 2010. In 2011, STUK Nuclear Materials Section approved one new person to be appointed responsible manager for nuclear safeguards at STUK and a deputy for this manager. STUK Nuclear Materials Section verified the physical inventory, inspected the site declaration and basic technical characteristics during the inspection on 29 June 2012, and concluded that the actions that were required in the previous inspection protocol of 2010 have been accomplished. Thus, the operating unit at STUK fulfils the requirements for national safeguards arrangements.

As the Government granted TVO a licence amendment for the final disposal of low and medium level nuclear waste in the operating waste repository in Olkiluoto on 22 November 2012, also state-owned radioactive and nuclear waste that is under the control of STUK can be emplaced in the operating waste repository in Olkiluoto in the future.

### 3.1.7 The University of Helsinki site

STUK carried out its inspection to the University of Helsinki site on 29 February 2012 to verify the site declaration and the inventory.

On the basis of its assessment and inspection results, STUK concluded that the University of Helsinki has complied with its nuclear safeguards obligations in 2012.

### 3.1.8 Minor nuclear material holders

In 2012 a few STUK inspections were focused on the minor nuclear material holders in order to assure that the capabilities and procedures are adequate. As a routine, STUK inspected the reports

from the minor nuclear material holders, but the in total two inspections to these minor holders' premises were remarkably fewer than in previous years, as both in 2010 and in 2011 STUK inspected all the minor holders. In 2012 two new minor holders reported their activities. On 8 March 2012 STUK and the Commission inspected the physical inventory of the University of Jyväskylä, MBA WDPJ. The inventory was correct, but the operator was requested to update the BTC.

On the basis of its assessment and inspection results, STUK concluded that the minor nuclear material holders have complied with their nuclear safeguards obligations in 2012.

### 3.1.9 Front-end fuel cycle operators

STUK granted an operation licence to Norilsk Nickel Harjavalta for producing, storing and handling uranium as a by-product of the nickel purification process for an annual amount of less than 10 metric tons in 2010. On 23 April 2012 STUK, the Commission and the IAEA carried out the first inspection to this operator and took samples from the solutions. The operator was requested to update the BTC. In conjunction to this inspection the inventory of OMG Kokkola Chemicals was verified on 25 April 2012 by the same inspectorates.

During early 2011 STUK evaluated the licence application of Talvivaara Sotkamo Ltd. to begin uranium production as a by-product at the Talvivaara nickel mine, which is located in Sotkamo. STUK made a statement to the Ministry of Employment and the Economy about the radiation and nuclear safety, security and safeguards issues. STUK and the Commission carried out the first Design Information Verification inspection to Talvivaara in November 2011. The aim was to become familiar with the site staff and to agree on reporting procedures. In 2012 the IAEA and the Commission visited Talvivaara on 27 April 2012 with the aim to get samples from the process. However, this was not yet possible at that time. The Ministry of Employment and the Economy and STUK visited Talvivaara in September, and later in November the mine areas under STUK's control, because environmental releases from Talvivaara mine were analysed also by STUK. Talvivaara Sotkamo Ltd. received Commission approval for the uranium off-take agreements with Cameco in November 2011 and a further ratifica-

tion by the Commission in accordance with the Euratom Treaty in January 2012. On 1 March 2012 the Finnish Government granted a licence in accordance with the Finnish nuclear legislation to Talvivaara Sotkamo Ltd. for the extraction of uranium from the Talvivaara mine.

Before the plant is commissioned, STUK shall inspect that all relevant arrangements are in place, including the nuclear safeguards handbook and responsible persons for nuclear materials accountancy. An environmental permit issued by the Regional State Administrative Agency is required before the extraction of uranium can start. According to the current estimates this may take place at the earliest in summer 2013.

### 3.1.10 The final disposal facility site for spent nuclear fuel

During the year 2012 STUK carried out four interim inspections to the underground premises of the final disposal facility. The IAEA and the Commission joined one of these by means of a Design Information Verification. The IAEA inspected the underground premises, the shaft, and the ventilation technology building where there will be access routes to the underground premises.

Posiva updated its non-proliferation handbook in April and August 2012 to clarify and update the descriptions of Posiva's safeguards practices. The update was approved by STUK in September 2012.

Several meetings were arranged between STUK, the Commission and the IAEA during the year 2012 in order to clarify and facilitate safeguards measures for the final disposal of spent nuclear fuel. These meetings were focused on the verification issues prior to spent fuel encapsulation. This issue was discussed with Posiva's design managers at the Safeguards-by-Design meeting on 29 March 2012, because it is important that designers are aware of the safeguards measures to be adapted to the facility at an early phase of facility development. As expected, Posiva submitted the nuclear construction licence application for the disposal facility to the Ministry of Employment and the Economy in December 2012. In addition, Posiva submitted to STUK a plan for arranging the safeguards control, which is necessary to prevent the proliferation of nuclear weapons as required by the section 35 of the Nuclear Energy Degree on 31 December 2012.

### 3.1.11 Verification of spent fuel

STUK performed non-destructive assay (NDA) verification measurement campaigns on spent fuel elements at both Loviisa and Olkiluoto NPP in 2012. At the Olkiluoto campaign, 20 – 22 March, STUK used the gamma Burn-Up Verification method (GBUV), which is a High-Purity Germanium (HPGe) gamma spectrometric measurement of the spent fuel, through a collimator slit in the wall of the fuel pond. 36 assemblies were successfully verified during this campaign. All measured elements exhibited the expected fission product spectrum. The relative Cs-137 count rates were consistent with burn-up data.

Following the successful practice from the previous year, also the measurements at the Loviisa NPP were made in one single three day campaign, instead of two shorter two day campaigns. The campaign at Loviisa, 12 – 14 November, was carried out with FORK equipment, which delivers a gross gamma signal from an ionisation chamber and a neutron count rate from a fission chamber. STUK's FORK equipment is sometimes referred to as eFORK (enhanced FORK), because it incorporates a CdZnTe gamma spectrometer, however the CdZnTe spectrometer, as well as one of the ionisation chambers in the eFORK are currently out of order. Even though the instrument is not in perfect condition, 34 assemblies were successfully verified during this campaign. The measurements at the Loviisa NPP did not indicate any inconsistencies in the reporting by the operator.

### 3.1.12 Nuclear dual use items, export licences

In 2012 the Ministry for Foreign Affairs issued six licences for exporting nuclear process modelling software to France, Germany (2), Japan and Poland (2) and three licences for exporting nuclear technology (nuclear information) for a nuclear power plant to Japan, France and Sweden. In addition, the Ministry issued one licence to export a piece of equipment to France.

### 3.1.13 Transport of nuclear materials and nuclear waste

In 2012, fresh nuclear fuel was imported to Finland from Germany, Sweden and the Russian Federation (Table 1). In relation to these imports, STUK approved three transport plans and two transport package designs. Also an approval for special ar-

rangements to be applied in one of these transports was issued by STUK. Furthermore, STUK granted approvals for route alterations for a transport of fresh nuclear fuel and for special arrangements in a nuclear waste transport. In addition, STUK granted extra time for submissions of material regarding several approval applications.

STUK inspected two transports of fresh nuclear fuel during the year. The inspections were performed in cooperation with the police who provided official assistance to STUK especially during the second inspection where STUK observed deficiencies in the licensee's transport documents. On request by TVO, STUK participated in two meetings during the year, where STUK's regulatory requirements in the new Guide YVL D.2 were discussed with both TVO and their nuclear fuel suppliers. Regarding the planned transports of natural uranium from the Talvivaara mine, STUK took part in one meeting and one tabletop exercise that were organised by Talvivaara Sotkamo Oy and Cameco Corporation.

### 3.1.14 International transfers of nuclear material

In 2012, TVO reported to STUK about its international fuel contracts, fuel transfers and fuel shipments. STUK carried out an on-site inspection where TVO's nuclear material accountancy on the fresh fuel imported in 2012 was verified against the original shipment documents, which cover the international transfers. The accountancy of the natural uranium in TVO's possession but stored outside of the Olkiluoto NPP site was also inspected. Based on the findings, STUK concluded that TVO has complied with its safeguards obligations when purchasing the nuclear fuel and managing its international transfers.

## 3.2 The Finnish National Data Centre for the Comprehensive Nuclear-Test-Ban Treaty

### 3.2.1 International cooperation is the foundation of CTBT verification

During 2011 the Finnish National Data Centre (FiNDC) participated in meetings of the Working Group B (WGB) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). WGB is a policy making



organ for the technical development of the verification regime. By participating in the work of WGB and its subsidiaries (workshops and expert groups), the FiNDC can provide technical expertise to the CTBTO, while also attending to the Finnish national interests.

In August a Linssi users' group meeting was held in Freiburg, Germany. The Linssi database system, developed jointly by STUK, Aalto University and Health Canada is an important part of the analysis capabilities of FiNDC. Several other NDCs have also adopted or are planning to adopt the Linssi database. During the year NDC staff from Australia, Austria and Germany visited FiNDC, to learn from and discuss the analysis process in use at the FiNDC.

### **3.2.2 The analysis pipeline is a well established daily routine**

The FiNDC continued developing its own monitoring system for the data received from the International Monitoring System's network (IMS). The FiNDC routinely analyses all radionuclide measurement data generated at the IMS radionuclide stations across the world. The IMS network is still developing, and the number of operational air filter stations was 66 at the end of 2012 (at the final stage there will be 80). The analysis pipeline is linked to the LINSSI database and equipped with an automated alarm system, to enable efficient and fully automated screening of the data.

The number of IMS stations equipped with radioxenon measurement capabilities was 30 at the end of 2012. Twelve IMS radioxenon systems were certified by the CTBTO at the end of 2012. Radioxenon measurements are especially important for CTBT verification, because xenon, as a noble gas, may leak also from underground tests, which seldom release particulate matter. The operational stations generated more than 1000 gamma and beta-gamma spectra per day for the FiNDC analysis pipeline to handle. The particulate pipeline is well established and has been running stably for many years, while FiNDC still needs some refinement of its xenon analysis capabilities.

## **3.3 International co-operation**

The implementation of safeguards in Finland was addressed at several meetings with the IAEA and the Commission. In addition, STUK continued its

participation in the ESARDA working groups and the steering committee meeting. STUK had strong influence in the ESARDA Executive Board and via ESARDA also at the INMM and IAEA conferences. The head of STUK's Security Technology Laboratory continued his term as the chairperson of the ESARDA Novel Approaches/Novel Technologies Working Group.

The progress at the Olkiluoto 3 unit, which has been under construction since 2003, and the more current authorisation of the new nuclear facilities in 2010 have given STUK practical experience in implementing safety, security and safeguards to new nuclear facilities. Owing to this, STUK experts have been invited on several occasions to present guidance and to share their experiences. Some of this activity has been facilitated via the Finnish Support Programme to the IAEA, but there have also been other mechanisms available to contribute to the world-wide co-operation. In addition, the new facilities in the front-end and the back-end of the fuel cycle – i.e. the extraction of uranium in mining and milling and the development of the geological repository – have widened the capabilities and scope of the Finnish national safeguards system.

Finland's bilateral cooperation programmes in the area of non-proliferation are directed mainly towards our neighbouring countries outside the EU and are motivated by the continued need for enhancing the regional security environment. Accordingly, STUK continued its cooperation programme with the Russian Federation. Collaboration with Ukraine in mutually beneficial areas was re-established in 2008 and an agreement about a programme was made between STUK and the State Nuclear Regulatory Committee of Ukraine, since 2011 the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU). As per this agreement, capacity building at the SNRIU was continued in 2012.

In 2012 STUK contributed to the inter-institutional development cooperation programme of the Ministry for Foreign Affairs by supporting the Geological Survey of Finland in its tasks related to uranium mining and milling in Namibia and Zambia. In both states there are plans for new uranium mining, but authorities need assistance when developing mining regulations. In the non-proliferation regime the main tasks are related to the

ratification and implementation of the Additional Protocol.

### 3.3.1 Support programme to the IAEA

The Nuclear Materials Section of STUK coordinates the Finnish Support Programme (FINSP) to IAEA safeguards. One of the main activities in 2012 was hosting an IAEA training workshop for nuclear newcomers – countries pursuing a nuclear power programme. The experiences of Finland were shared with the participants who represented 17 countries (Figure 9). The workshop was arranged at STUK and at Olkiluoto facilities on 8 – 12 October 2012. The visit to the Olkiluoto 3 construction site clarified the needs for early interaction between the regulators and stakeholders during any large nuclear project. The information provided was useful for all countries, but every country has to develop its own models to co-operate with the IAEA in all areas of safety, security and safeguards (3S) and then adapt these in the national infrastructure and legislation as appropriate.

Other activities included the development of a partial defect verification tool based on Passive Gamma Emission Tomography, training visits for IAEA experts, the development of safeguards for

geological repositories, and the development of novel technologies for the IAEA.

### 3.3.2 Final disposal programme and the ASTOR group

In 2012, the group of experts for the Application of Safeguards to Geological Repositories (ASTOR) met at the IAEA in Vienna on 29 – 30 October. It was noted that the repository programmes in Sweden and in Finland have reached the licensing phase, and the safeguards measures are to be agreed to by all parties: facility designers, operators and the inspectorates. The IAEA and the Commission presented their safeguards approaches at the ASTOR meeting. In addition to the repository safeguards, verification of spent nuclear fuel prior to disposal was addressed, and a separate meeting on this issue was arranged on 31 October. A new task force consisting of the IAEA, the Commission, and Finnish and Swedish authorities and operators was founded during the ASTOR meeting. The first Low Level Liaison Committee (LLLC) Encapsulation Plant and Geological Repository (EPGR) Liaison Group meeting was scheduled for January 2013 in Vienna and the 2013 ASTOR meeting for June 2013 in Olkiluoto.

Novel technologies to be applied for safeguards



**Figure 9.** Representatives from nuclear newcomer countries in Olkiluoto.

purposes at this new type of facility were discussed during the year 2012. The prototype for the tomographic spent-fuel detector system was successfully tested at the Joint Research Centre (JRC) in Ispra. The tests are to be continued at the Finnish repository facilities in real conditions. Two representatives of the U.S. Nuclear Regulatory Commission (NRC) visited the Olkiluoto repository site in May 2012 (Figure 10) in order to improve awareness of geological repository safeguards in areas such as the continuity of knowledge, verification techniques for spent fuel, containment surveillance, the design information questionnaire, and remote monitoring. Seismic monitoring experiences from Olkiluoto and Gorleben were presented and discussed during the German Support Programme visit to Finland in June 2012. The IAEA and the Commission participated in the technical visit. In October, two satellite imagery analysts of the IAEA made a site visit to the Olkiluoto facilities, both to the power plant and to the geological repository site. One of the new topics discussed was the possible future implementation of digital site declarations. All these topics and the related visits are in the interests of the ASTOR group and the Finnish Support Programme.

### 3.3.3 Cooperation with the Rostekhnadzor, Russia

Cooperation between Finnish and Russian authorities, technical support organisations, industrial partners, and the status of the cooperation programme were reviewed in the meeting in July. The demonstration of the spent fuel attribute tester (SFAT) measurement device for the Rostekhnadzor was successfully carried out in 2008 at the Kola nuclear power plant. Since then a new computer was obtained for the system and software was installed and further steps were taken to organize the shipment to the Ozersk Office of the Rostekhnadzor in 2012. This bilateral work complements the work done within the EU-financed TACIS project, which aims at improving the control of the handling of nuclear materials at the Mayak reprocessing plant.

### 3.3.4 Capacity building in Ukraine

From 2009 to 2010 the focus of the programme with Ukraine was on manufacturing and delivering a mobile laboratory vehicle for the use of the State Nuclear Regulatory Inspectorate of Ukraine

(SNRIU). The mobile measuring laboratory, called Sophisticated ON-site Nuclide Identification (SONNI) enables identifying and analysing radioactive sources and nuclear materials in the environment, at industrial facilities and in cases of threatening situations. The laboratory includes measuring, sampling, positioning and communication systems. Data can be transmitted in real time to the control centre, where the data can be entered into a map system, thus providing real-time information for the management of the operations. At locations where the vehicle cannot have access, a portable application with the same functionality can be used. The capacity building in this area is financed by the Ministry for Foreign Affairs.

The modern radiation measuring vehicle together with the portable application unit was donated to the IAEA and further to the SNRCU in Kiev in December 2010. Two one-week long educational sessions were organised in autumn of 2011 to train the new crews and a field exercise was conducted in December 2011. The work continued during 2012 with field exercises and the provisioning of additional equipment and measurement devices. The technology was in full use during the EURO 2012 football event, including the real-time expert support to the vehicle team operating in the field.

As continuation to this training, a new project was approved by the Commission to strengthen the SNRIU's capabilities to provide independent radiation monitoring by using the mobile laboratory. The SNRIU capacity building continued 2012 in the form of a mission to monitor the performance of the monitoring teams during the EURO 2012, the results of the work were presented at the EUROSAFE Forum in Brussels in November 2012. Also a workshop was held in November to plan for the practical exercises in 2013: joint surveys and inspections of public gatherings, of territories with medical institutions that use radiation and nuclear technologies, and around uranium mining and milling facilities. Special emphasis will be given to the use of the mobile laboratory as a part of normal regulatory activities.

In addition, another EU project was implemented to enhance border control functions by provisioning conventional radiation detectors and new technical means for protection against chemical, biological, radiological and nuclear (CBRN) threats. At the selected border stations between



Poland and Ukraine training was arranged for 30 border control officers in November 2012.

### 3.3.5 Regulations for uranium mining and milling

STUK and the Geological Survey of Finland are cooperating under the financing instrument “inter-institutional development and cooperation” which was launched in 2008 by the Ministry for Foreign Affairs (MFA) to promote small-scale projects between government authorities and agencies. The Finnish public sector participates in development cooperation by cooperating with the partner countries’ public sector. The objective of the projects is to support capacity-building in the partner agencies. In June 2012 the Geological survey facilitated the IAEA interregional training course on “Supporting Uranium Exploration, Resource Augmentation and Production Using Advanced Techniques”. STUK and the Ministry of Employment and the Economy (MEE) participated and presented the current development in its legislative framework in Finland. In August, the Geological Survey and STUK participated in the OECD/NEA IAEA Uranium Group meeting in Kirovograd in Ukraine, giving the national report for Finland jointly. In the future, the Uranium Group will also concentrate on the

regulations concerning uranium production and therefore the participation of regulatory bodies is desired. In addition to the official meeting focused on uranium resources, production and demand, the hosting country provided visits to the uranium mining and milling facilities (Figure 11). Thus, the participation in the working group provided STUK with a possibility to gain additional support and industrial viewpoints to the support for the regulatory control of the uranium production facilities. This gave important support to the continuation of the co-operation with Ukraine described in the previous chapter.

The Namupol project (Support for Drafting of Uranium Mining and Milling Policy, Legislation and Regulations and Development of Minerals Database) has its origins in a visit to Namibia by the Finnish Minister for Foreign Trade and Development in October 2008. In consultations with the Namibian minerals sector, half a dozen topics were identified and the need for a uranium production policy was considered to be the most pressing issue. Owing to the rapid upsurge in exploration for uranium in Namibia, the government had been forced to impose a moratorium on the issuance of new licences. The Ministry of Mines and Energy of Namibia and the Geological



Figure 10. NRC visit to the Olkiluoto geological repository.



Survey of Finland submitted a project proposal to the MFA in April 2009. This was revised in 2009 and radiation protection issues and nuclear regulations were incorporated in the proposal. An assignment was received from the MFA in September 2010 and the first policy workshop was held in Namibia in November 2010 with participants from the Namibian stakeholders and Finnish partners, Geological Survey, STUK, and the MFA. At this workshop, it was announced that Namibia needs to have regulation, not only for the uranium mining and milling, but also for the whole nuclear fuel cycle. This raised the importance of non-proliferation regulations since uranium production does not implicitly require safeguards measures like the fuel cycle facilities and related technology. The draft nuclear fuel cycle policy was written in 2011, and two stakeholder workshops were held, in September and December 2011. The final guidance report from the Finnish side was delivered in May 2012.

In Zambia, there are no current industrial uranium mining activities, though uranium has been mined in the past. Currently uranium is stockpiled and overseen at one of the Zambian copper mines as by-product, and in addition one mining licence

application for uranium mining in sandstone has been submitted to the local authorities. The national legislation has recently been updated for the mining of uranium. However, the MFA identified the need to improve legislation and financed the Geological Survey of Finland and STUK to carry out a mission to Zambia in 2011 to assess the mining, environmental and radiation protection legislation and relevant competences at the responsible authorities, i.e. the Zambian Ministry of Mines and Minerals Development, the Environmental Management Agency and the Radiation Protection Authority. In addition, the preparedness to implement the Additional Protocol and integrated safeguards was addressed. The “Workshop on Different Aspects to the Uranium Production Cycle” was arranged in Lusaka, Zambia on 23 – 27 April 2012. The different stakeholders, including authorities, universities, non-governmental organisations and exploration and production companies, took actively part in the workshop. As a result, a uranium working group was nominated to advice the Zambian government, in particular the Ministry of Mines. Participants from Finland, Namibia and the IAEA were also nominated to serve as advisors in the national working group.



**Figure 11.** Uranium milling plant in Zholtie Vody, Ukraine.

## 4 Human resources development

Nuclear safeguards by the Nuclear Materials Section of STUK cover all typical measures of a State System of Accounting for and Control of Nuclear Materials (SSAC), and many other activities besides. The nuclear fuel cycle related activities, e.g. research and development activities not involving nuclear material or the manufacture of certain equipment as defined in the Additional Protocol have extended the scope of traditional safeguards. Nuclear safeguards on the national level are closely linked with the other functions of nuclear materials control and non-proliferation: licensing, export control, border control, transport control, combating illicit trafficking, the physical protection of nuclear materials, and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The continuous analysis of the developments in the involved fields of both technology and politics is a daily, multidisciplinary task at the STUK Nuclear Materials Section.

The personnel's competence is systematically developed, taking into account the needs of the organisation and the wishes of the individuals (see Figure 12). Those aiming at an expert's career are valued as highly as those interested in managerial duties. In 2012, one of the staff members participated in the specialist qualification for management and leadership organised for state officials. The participants came from the Ministry of Social Affairs and Health and agencies under its supervision. Most of the education and training to develop management and leadership skills happens at the workplace. Two of the staff members participated in and completed the 5-week national course for nuclear safety and one of the inspectors attended the Euratom training course on European Nuclear Safeguards in Luxembourg. The IAEA course for nuclear newcomer states arranged in Finland served also as internal education and training. An

internal two day seminar was held in March to prepare for the procedures needed to implement safeguards at the disposal facility for spent nuclear fuel.

The RADAR project to upgrade radiation monitoring systems at Finnish border crossing stations was launched in 2009 and will run up to 2014. The aim of the project is to modernise radiation monitoring equipment at border crossing stations and to educate the personnel at the stations. The project is run in cooperation with Finnish Customs, the end-user of the equipment. Antti Hannula was employed at STUK as trainee during the summer to assist the instrumentation at the border control stations. The main outcome of 2012 was the procurement of the Kotka-Hamina harbour system, which will be installed in early 2013. The system's novel architecture facilitates quick response in case of alarms.

In addition to being the responsible section for the above described areas, the personnel of the Nuclear Materials Section assist other sections in response to any incidents that may include nuclear materials or require their expertise for any other reason. Some of the Nuclear Materials Section staff are also part of the pool of Experts-on-Duty, who receive the notifications for incidents and are responsible for initiating STUK's response. In 2012, the general cost-efficiency requirements affected STUK's ability for immediate responses. The public and media service and the National Data Centre for CTBT were reduced to office-hours service and the resources to have an inspector on alert were reduced. One of the staff members worked half-time for emergency preparedness and another person transferred to the Nuclear Reactor Regulation department at the end of the year.

The distribution of the working days of the Nuclear Materials Section in the different duty ar-

eas is presented in Figure 13. Most of the working days are subject to a charge from the stakeholders. As seen in Figure 13, the duty areas are divided into those of direct oversight and inspections (basic operations), to support functions including maintenance and development work for the regulatory functions, to consultancy including e.g. internation-

al cooperation financed by the Ministry for Foreign Affairs or the EU, and to the RADAR project, which supports Finnish Customs. State budgetary funding constitutes less than 10 % of the total funding of the Nuclear Materials Section.

At the request of the Ministry of Employment and the Economy, an international team of senior

The staff of STUK Nuclear Materials Section. All section staff participate in the core safeguards tasks. Additionally, each person has some special areas of expertise to focus on.

Mr. Tapani Honkamaa	Senior Inspector	The RADAR project, FINSP to the IAEA safeguards
Mr. Timo Ansaranta	Inspector	Control of operators' competence at facilities
Mr. Antti Hannula	Trainee	The RADAR project
Ms. Ritva Kylmälä	Assistant	
Ms. Elina Martikka	Section Head	Management
Ms. Anna Lahkola	Senior Inspector	Transport of nuclear materials and nuclear waste, database of nuclear materials
Mr. Mikael Moring	Senior Inspector	Finnish National Data Centre for the CTBT, safeguards for final disposal
Mr. Antero Kuusi	Inspector	Databases, non-destructive assay
Mr. Olli Okko	Senior Inspector	Safeguards of research and development, final disposal
Mr. Marko Hämäläinen	Senior Inspector	Inspection coordination, Additional Protocol related matters

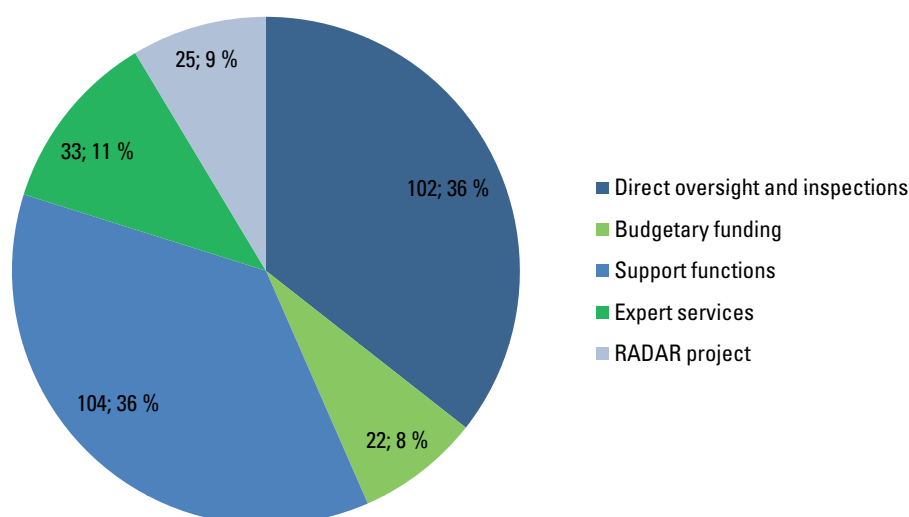


**Figure 12.** The staff of the Nuclear Materials Section.

safety experts met representatives of STUK 15 – 26 October 2012 to conduct an Integrated Regulatory Review Service (IRRS) mission. The purpose of the peer review was to review the Finnish regulatory framework for nuclear and radiation safety. One of the general recommendations to improve STUK practices in the IAEA final report was that “STUK should further enhance the effectiveness of its inspection activities by developing a formal qualification programme for inspectors, making more use of and clarifying the processes for unannounced and reactive inspections, and extending the use of the graded approach for planning and conducting inspections across all regulated facilities and

activities”. Although the IRRS is not focused on safeguards, the qualification programme for safeguards inspectors and facility representatives was also addressed during the visit at STUK. Moreover, two staff members of the U.S. Nuclear Regulatory Commission (NRC) visited STUK in September in order to familiarise themselves with the current qualification requirements for safeguards personnel both at the authority organisation and at the facilities. Such competence assurance will be one of the cornerstones of future work and an important part of the new strategy to be implemented with the reduced resources of the Nuclear Materials Section.

**Distribution of working days**



**Figure 13.** The distribution of working days of the Nuclear Materials Section in the different duty areas.

## 5 Conclusions

STUK continued with national safeguards measures and activities with 62 inspection days and 42 inspections. The implementation of the International Atomic Energy Agency (IAEA) integrated safeguards began in Finland on 15 October 2008. After 2009 the number of IAEA and European Commission inspection days has been somewhat higher, because of the higher number on random interim inspections, partly owing to new stakeholders to be inspected. Since 2010 the number of inspection days annually has been close to 20. The implementation of the IAEA integrated safeguards reduces the total number of annual routine inspections days of the international inspectorates, but it includes short notice random inspections. In order to be present at all of the short notice IAEA inspections STUK has had preparedness to have a daily on-the-alert inspector.

In 2012 STUK performed 25 safeguards inspections at the Finnish nuclear power plants (NPP), nine at the Loviisa NPP and 16 at the Olkiluoto NPP. The Commission and the IAEA took part in 14 and 13 of these inspections, respectively. STUK performed two non-destructive assay measurement campaigns, one at the Loviisa NPP and one at the Olkiluoto NPP. In 2012 STUK carried out two inspections to the minor nuclear material holders. At other facilities, the Commission took part in the physical inventory verification at the University of Jyväskylä and at the VTT research reactor, and together with the IAEA in inspections to the front-end facilities in Harjavalta, Kokkola and Talvivaara, as well as in the design information verification of the geological repository at the final disposal site at Olkiluoto. The total number of safeguards inspections in 2012 was 42 for STUK, 21 for the Commission, and 18 for the IAEA. The IAEA sent its safeguards statements to the Commission, which amended them with its own conclusions and forwarded them to STUK. The conclusions by the Commission were in line with the IAEA's remarks as well as with STUK's own find-

ings; there were no outstanding questions by the IAEA or the Commission at the end of 2012.

The results of STUK's nuclear safeguards inspection activities continued to demonstrate that the Finnish licence holders take good care of their nuclear materials. There were no indications of undeclared materials or activities and the inspected materials and activities were in accordance with the licence holders' declarations. Organisational safeguards procedures and nuclear material accountancy were remarked on for one of the stakeholders during the year. Neither the IAEA nor the Commission made any remarks nor did they present any required actions based on their inspections. By their nuclear materials accountancy and control systems, all licence holders enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards and non-proliferation.

In 2012 STUK's Nuclear Materials Section co-operated closely with the IAEA order to share experiences and train authorities' staff in countries that are aiming at nuclear programmes i.e. uranium production or nuclear energy. STUK co-operated with the Finnish Customs to offer expert advice in the development of radiation monitoring at borders, including training for Customs officers.

A major goal of all current Comprehensive Nuclear-Test-Ban Treaty (CTBT) related activities is the entry into force of the CTBT itself. To reach this goal, major steps have to be taken in the political arena, and an important prerequisite for positive political action is that the verification system of the CTBTO is functioning and able to provide assurance to all parties that it is impossible to make a clandestine nuclear test without getting detected. The FiNDC is committed to its own role in the common endeavour so that the verification system of the CTBTO can accomplish its detection task. While still incomplete, the verification system has already demonstrated its ability to detect nuclear tests.

## 6 Publications

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## 7 Abbreviations and acronyms

**ADR**

European Agreement concerning the International Carriage of Dangerous Goods by Road

**AP**

Additional Protocol to the Safeguards Agreement

**AQG**

Atomic Questions Group of the Council of the European Union

**ASTOR**

Application of Safeguards to Geological Repositories

**BTC**

Basic Technical Characteristics

**CA**

Complementary Access

**CBRN**

Chemical, biological, radiological and nuclear (such as in “protective measures taken against CBRN weapons or hazards”)

**CdZnTe**

Cadmium zinc telluride

**CTBT**

Comprehensive Nuclear-Test-Ban Treaty

**CTBTO**

Comprehensive Nuclear-Test-Ban Treaty Organization

**DIQ**

Design Information Questionnaire

**DIV**

Design Information Verification

**DU**

Depleted uranium

**eFORK**

enhanced FORK with a CdZnTe-gamma spectrometer (see FORK)

**ES**

Environmental Sampling

**ESARDA**

European Safeguards Research and Development Association

**EU**

European Union

**FA**

(1) Facility Attachment according to the Safeguards Agreement (INFCIRC/193),  
(2) Fuel Assembly

**FiNDC**

Finnish National Data Centre for the CTBT

**FINSP**

Finnish Support Programme to the IAEA Safeguards

**FORK**

Spent fuel verifier with gross gamma and neutron detection

**GBUV**

Gamma Burnup Verifier

**GICNT**

Global Initiative for Combating Nuclear Terrorism

**HEU**

High-enriched uranium

**HPGe**

High-Purity Germanium

**IAEA**

International Atomic Energy Agency

**IMS**

International Monitoring System (of the CTBTO)

**ITU**

Institute of Transuranium Elements in Karlsruhe

**INFCIRC**

Information Circular  
(IAEA document type, eg.  
INFCIRC/193, Safeguards  
Agreement, or INFCIRC/140,  
the Non-Proliferation Treaty)

**IPPAS**

International Physical  
Protection Advisory Service

**IRRS**

Integrated Regulatory  
Review Service

**IS**

Integrated Safeguards

**ISSAS**

International SSAC Advisory  
Service

**ITWG**

International Technical  
Working Group for combating  
illicit trafficking of nuclear  
and other radioactive  
materials

**JRC**

The Joint Research Centre

**KMP**

Key Measurement Point

**LEU**

Low-enriched uranium

**LINSSI**

an SQL database for gamma-  
ray spectrometry

**MBA**

Material Balance Area

**MEE**

Ministry of Employment and  
the Economy

**MFA**

Ministry for Foreign Affairs

**NDA**

Non-Destructive Assay

**NM**

Nuclear Material

**NPP**

Nuclear Power Plant

**NPT**

The Treaty on the Non-  
proliferation of Nuclear  
Weapons (INFCIRC/140,  
“Non-Proliferation Treaty”)

**NSG**

Nuclear Suppliers’ Group

**NRC**

U.S. Nuclear Regulatory  
Commission

**OECD/NEA**

Organisation for Economic  
Co-operation and  
Development /Nuclear  
Energy Agency

**Onkalo**

Underground rock  
characterisation facility (for  
the final disposal of spent  
nuclear fuel)

**PIT**

Physical Inventory Taking

**PIV**

Physical Inventory  
Verification

**PSP**

Particular Safeguards  
Provisions

**PTS**

Provisional Technical  
Secretariat (to the  
Preparatory Commission of  
the CTBT)

**Pu**

Plutonium

**RL07**

Radionuclide Laboratory  
in the CTBT IMS network  
hosted by STUK (FIL07)

**SA**

Subsidiary Arrangements

**SFAT**

Spent Fuel Attribute Tester

**SNRCU**

State Nuclear Regulatory  
Commission of Ukraine

**SNRI**

Short Notice Random  
Inspection

**SNRIU**

State Nuclear Regulatory  
Inspectorate of Ukraine

**SNUICA**

Short notice, unannounced  
inspection, complementary  
access, on-alert inspector

**SSAC**

State System of Accounting  
for and Control of Nuclear  
Materials

**SSM**

Swedish Radiation Safety  
Authority

**Th**

Thorium



**U**

Uranium

**VTT**

Technical Research Centre of  
Finland

**UI**

Unannounced Inspection

**WGB**

Working Group B (of the  
CTBTO)

**UNSC**

United Nations Security  
Council

## APPENDIX 1 Nuclear materials in Finland in 2012

**Table 1.** Summary of nuclear fuel receipts in 2012.

To	From	FA	LEU (kg)
<b>Olkiluoto 1, WOL1</b>	Germany	110	19 189
<b>Olkiluoto 2, WOL2 (1/2)</b>	Sweden	60	10 360
<b>Olkiluoto 2, WOL2 (2/2)</b>	Sweden	56	9 673
<b>Loviisa NPP, WLOV</b>	Russian Federation	90	11 322

FA = fuel assembly; LEU = low-enriched uranium.

**Table 2.** Fuel assemblies at 31 December 2012.

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
<b>Olkiluoto 1, WOL1</b>	1 249/669	213 254	1 038
<b>Olkiluoto 2, WOL2</b>	1 231/659	204 720	968
<b>Olkiluoto, spent fuel storage, WOLS</b>	6 556/6 556	1 110 318	9 306
<b>Loviisa NPP, WLOV</b>	5 199/4 507	603 177	5 529

MBA = material balance area, FA = fuel assembly, SFA = spent fuel assembly

\*) FAs in core are accounted as fresh fuel assemblies

(Loviisa NPP 313 FAs and Olkiluoto NPP 500 FAs per reactor)

**Table 3.** Total amounts of nuclear material at 31 December 2012.

MBA	Natural U (kg)	Enriched U* (kg)	Depleted U (kg)	Plutonium (kg)	Thorium (kg)
<b>WOL1</b>	–	213 300	–	1039	–
<b>WOL2</b>	–	204 764	–	968	–
<b>WOLS</b>	–	1 110 318	–	9 306	–
<b>WLOV</b>	–	603 178	–	5 529	–
<b>WRRF</b>	1 511	60.098	0.002	< 0.001	0.048
<b>WFRS</b>	0.551	0.537	105.11	~ 0	0.178
<b>WKKO</b>	2 709.7	–	–	–	–
<b>WNNH</b>	2 623.55	–	–	–	–
<b>WHEL</b>	49.716	0.293	20.010	0.003	2.942
<b>Minor holders</b>	0.061	0.00116	1 314.5	~ 0	0.163

MBA = material balance area, WRRF = VTT FIR1/VTT Processes, WFRS = STUK, WKKO = OMG Kookola Chemicals, WNNH = Norilsk Nickel Harjavalta, WHEL = Laboratory of Radiochemistry at the University of Helsinki, U = uranium. \*) Less than 150 g of high-enriched uranium, mainly used in detectors.

## APPENDIX 2 Safeguards field activities in 2012

General information			Inspections			Inspection person days		
MBA	Date	Inspection type	IAEA	COM	STUK	IAEA	COM	STUK
WRRF	7 February	Interim inspection, site	0	0	1	0	0	2
WHEL	29 February	PIV + site	0	0	1	0	0	1
WLOV	6 March	Interim inspection C&S, DIV, site, RDT	0	1	1	0	1	1
WDPJ	8 March	PIV	0	1	1	0	1	1
WOLF	27 March	As built DIV, site	0	0	1	0	0	1
WOL1, WOL2, WOLS	27 March	Interim inspection	0	0	3	0	0	3
WOL1	13 April	SNRI	1	1	1	1	1	1
WNNH	23 April	PIV + IAEA technical visit	1	1	1	1	1	1
WKKO	25 April	PIV + IAEA technical visit	1	1	1	1	1	1
WTAL	27 April	Technical visit	1	1	1	1	1	1
WOL1, WOL2	30 April	Pre-PIT	2	2	2	2	2	2
WOL1	13 May	OL1 core verification	0	0	1	0	0	1
Outokumpu Stainless Oy	29 May	PIV, system inspection	0	0	1	0	0	1
WOL2	2 June	OL2 core verification	0	0	1	0	0	1
WOLF	13 June	As built DIV	0	0	1	0	0	1
WOL1, WOL2, WOLS	12–14 June	PIV	3	3	3	3	3	3
TVO, Helsinki Headquarter	29 June	International nuclear material transfers (accountancy and control)	0	0	1	0	0	1
WFRS	29 June	DIV, site	0	0	2	0	0	2
WLOV	1–2 August	Pre-PIT	1	1	1	2	2	2
WLOV	10–12 August	Transfer cask verification (×2)	2	2	2	2	2	2
WLOV	3 September	Transfer cask verification	1	1	1	1	1	1
WLOV	5 September	Transfer cask verification, LO1 core verification	1	1	2	1	1	2
WRRF	6 September	PIV	0	1	1	0	1	1
WOLF	6 September	As built DIV	1	1	1	1	1	1
WOL3	6 September	DIV	1	1	1	1	1	1
WLOV	28–29 September	LO2 core verification	0	0	1	0	0	1
WOL1, WOL2, WOLS	9 October	Interim inspection	0	0	3	0	0	3
WOLS	17 October	SNRI	1	1	1	1	1	1
WLOV	30–31 October	Post-PIT, DIV	1	1	1	2	2	3
WOLF	11 December	As built DIV	0	0	1	0	0	1
<b>NDA MEASUREMENTS</b>								
WOL1	20–22 March	GBUV	0	0	1	0	0	9
WLOV	12–14 October	Fork	0	0	1	0	0	9
<b>TOTAL</b>			<b>18</b>	<b>21</b>	<b>42</b>	<b>20</b>	<b>23</b>	<b>62</b>

Note: At the Olkiluoto NPP, inspections are counted per MBA. MBA = material balance area, PIV = Physical Inventory Verification, CV = Core Verification, CA = Complementary Access, ES = Environmental Sampling, NM = nuclear material, SFAT/eFORK/GBUV = methods of non-destructive assay.

## APPENDIX 3 International agreements and national legislation relevant to nuclear safeguards in Finland

Valid legislation, treaties and agreements concerning safeguards of nuclear materials and other nuclear items at the end of 2012 in Finland (Finnish Treaty Series, FTS):

1. The Nuclear Energy Act, 11 December, 1987/990 as amended.
2. The Nuclear Energy Decree, 12 February, 1988/161 as amended.
3. The Treaty on the Non-proliferation of Nuclear Weapons INFCIRC/140 (FTS 11/70).
4. The Agreement with the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of Netherlands, the European Atomic Energy Community and the International Atomic Energy Agency in Implementation of Article III, (1) and (4) of the Treaty on Non-Proliferation of Nuclear Weapons (INFCIRC/193), 14 September 1997. Valid for Finland from 1 October 1995.
5. The Protocol Additional to the Agreement between the Republic of Austria, the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, the Hellenic Republic, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of Netherlands, the Portuguese Republic, the Kingdom of Spain, the Kingdom of Sweden, the European Atomic Energy Community and the International Atomic Energy Agency in Implementation of Article iii, (1) and (4) of the Treaty on Non-Proliferation of Nuclear Weapons, 22 September 1998. Entered into force on 30 April 2004.
6. The Treaty establishing the European Atomic Energy Community (Euratom Treaty), 25 March 1957:
  - Regulation No 5, amendment of the list in Attachment VI, 22 December 1958
  - Regulation No 9, article 197, point 4 of the Euratom Treaty, on determining concentrations of ores, 2 February 1960.
7. Commission Regulation (Euratom) No 302/2005, 8 February 2005
8. Council Regulation (EC) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering, and transit of dual use items.
9. The Agreement with the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy (FTS 16/69). Articles I, II, III and X expired on 20 February 1999.
10. The Agreement with the Government of the Russian Federation (the Soviet Union signed) and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy (FTS 39/69). Articles 1, 2, 3 and 11 expired on 1.12.2004.
11. The Agreement between the Government of the Kingdom of Sweden and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy 580/70 (FTS 41/70). Articles 1, 2 and 3 expired on 5.9.2000.

12. The Agreement between Sweden and Finland concerning guidelines on export of nuclear materials, technology and equipment (FTS 20/83).
13. The Agreement between the Government of Republic of Finland and the Government of Canada and Canada concerning the uses of nuclear materials, equipment, facilities and information transferred between Finland and Canada (FTS 43/76). Substituted to the appropriate extent by the Agreement with the Government of Canada and the European Atomic Energy Community (Euratom) in the peaceful Uses of Atomic Energy, 6 October 1959 as amended.
14. The Agreement on implementation of the Agreement with Finland and Canada concerning the uses of nuclear materials, equipment, facilities and information transferred between Finland and Canada (FTS 43/84).
15. The Agreement between the Government of Republic of Finland and the Government of Australia concerning the transfer of nuclear material between Finland and Australia (FTS2/80). Substituted to the appropriate extent by the Agreement between the Government of Australia and the European Atomic Energy Community concerning transfer of nuclear material from Australia to the European Atomic Energy Community.
16. The Agreement for Cooperation with the Government of the Republic of Finland and the Government of the United States concerning Peaceful Uses of Nuclear Energy (FTS 37/92). Substituted to the appropriate extent by the Agreement for Cooperation in the Peaceful Uses of Nuclear Energy with European Atomic Energy Community and the USA.
17. The Comprehensive Nuclear-Test-Ban Treaty (FTS 15/2001). This treaty was ratified by Finland in 2001, but will not enter into force before it is ratified by all 44 states listed in Annex II of the treaty.